TECHNICAL MANUAL

Model: labtech™
Scaler/Ratemeter/Analyzer

BICRON®

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ELECTRONIC PRODUCTS
STANDARD WARRANTY

Instruments and options manufactured by Bicron are warranted against defects in materials and workmanship for a period of two years from the date of shipment, unless otherwise agreed upon by Bicron and the customer.

Bicron's obligation with regard to such products shall be limited to repair or replacement, FOB Bicron factory or authorized repair station, at Bicron's option.

The calibration (when applicable) for each instrument is warranted to be within its specified accuracy at the time of shipment. If this initial calibration is determined to be in error, the instrument will be recalibrated at no charge, provided it is returned as described above.

EXCLUSION OF WARRANTY

The aforesaid warranty does not cover instruments, options or probes which are subject to excessive physical abuse or are used for purposes other than those intended. In no event shall Bicron be liable for consequential or special damages, transportation, installation, adjustment, work done by customer or other expenses which may arise in connection with such defective product or parts.

There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face hereof. This express warranty excludes coverage of and does not provide relief for incidental or consequential damages of any kind or nature, including, but not limited to loss of use, loss of sales or inconvenience. The exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the instrument at Bicron's option.

This warranty specifically excludes the following items which are covered by their original manufacturer's warranties: photomultiplier tubes, GM and proportional tubes, crystal and other solid-state detectors, and batteries.

BICRON CORPORATION
ELECTRONIC PRODUCTS

PROCEDURES and CAUTIONS

The equipment herein described is designed and manufactured in compliance with all applicable safety standards. Nevertheless, certain hazards are inherent in the use of electronic and radiometric equipment.

Adequate warnings are included in the manual and on the product itself to cover hazards that may be encountered in normal use and servicing of this equipment. No other procedures are warranted by Bicron.

It shall be the owner's or user's responsibility to see to it that the procedures and cautionary notes are heeded.

Failure on the part of the user in any way to follow the prescribed procedures shall absolve Bicron and its agents from any resulting liability.

This instrument is intended solely for the detection and measurement of ionizing radiation. It should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation.

All instructions and warnings contained in this manual or on the instrument must be read before use and must be strictly followed. Failure to follow these instructions and warnings may result in inaccurate readings and/or user hazard.

Indicated battery and other operational tests must be performed prior to each use to assure that the instrument is functioning properly.

*****CAUTION*****

FAILURE TO CONDUCT PERIODIC PERFORMANCE TESTS IN ACCORDANCE WITH ANSI N323-1978, PARAGRAPHS 4.6 AND 5.4, AND TO KEEP RECORDS THEREOF IN ACCORDANCE WITH PARAGRAPH 4.5 OF THE SAME STANDARD, COULD RESULT IN ERRONEOUS READING OF POTENTIAL DANGER. ANSI N323-1978 BECOMES, BY THIS REFERENCE, A PART OF THIS OPERATING PROCEDURE.

INSPECTION

Instruments should be examined and tested as soon as received. Claims for transportation damages, if any, should be filed at once with the delivery carrier.

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1.0 GENERAL DESCRIPTION

The Bicron labtech is a compact, lightweight instrument which features a microprocessor controlled scaler, ratemeter, and single channel analyzer combined in a single versatile package.

This model also features a crystal controlled time base, 7 decade LED display, preset time and preset count modes, 3 mode single channel analyzer, rechargeable batteries, and an audible alarm. The unit is compatible with both GM and scintillation detectors.

A unique feature of the scaler allows the user to interrupt a measurement to call up the elapsed time or counts, the preset time or counts, the calculated average CPM and resume the measurement at the point of interruption.

1.1 SPECIFICATIONS

DETECTOR: Choice of GM and scintillation detectors
HIGH VOLTAGE: Electronically stabilized, adjustable to 2000V via a calibrated turns counting dial, with readout on the meter
CONNECTOR (detector): MHV
INPUT SENSITIVITY: Adjustable from 0.1 to 1 V via a turns counting dial
WARMUP TIME: None
POWER REQUIREMENTS: AC, 110V/60 Hz or 220V/50 Hz, switch selectable
BATTERY: Rechargeable gelled cells which provide 8 hrs. of operation
RECHARGE: Automatic when unit is connected to line power; unit may be either on or off
AUDIO: Switch-selectable to provide an audible 'click' for each detector pulse, or an audible alarm
ALARM: Audible, non-latching rate alarm with front panel adjustment from 10% to 130% of full scale and readout on the meter
AUDIO CONTROL: Three position rotary switch - off, pulse, alarm
TEMPERATURE: Operational from -20° to +50°C
HUMIDITY: < 5% change in reading from 10-95% RH
SIZE: 12.5" L x 7.5" D x 5.5" H including feet and folded handle (31.8 x 19.1 x 14.0 cm)
WEIGHT: 7.0 lbs. (3.2 kg)

SCALER SECTION

OPERATING MODES: Switch-selectable as follows:
Manual - continuous counting
Preset Time - 0.1 to 999.9 min.in 0.1 min. increments, stored in memory
Preset Count - 100 to 999,000 counts in 100 count increments, stored in memory
Test - Exclusive self-test of scaler operation
RANGE: 0-9,999,999 counts; 0-99,999.99 minutes
TIMER: Crystal controlled time base with an accuracy of 0.05% or better, AC or battery power
DISPLAYS: Seven decade LED; indicator lamps for 'elapsed', 'preset', 'minutes' and 'counts'
CONTROLS: Four position rotary switch for mode selection; push buttons for count, hold, reset and set

RATEMETER SECTION

RANGE: 0-1,000,000 CPM in four linear ranges
ACCURACY: Within 10% of reading between 20% and 100% of full scale on any range
RESPONSE TIME: Switch-selectable, optimized for each range, 0-90% of final reading as follows:

Range	Time	
	Fast	Slow
X1	8 sec.	15 sec.
X10	1 sec.	5 sec.
X100	<1 sec.	2 sec.
X1000	<1 sec.	1 sec.

METER: Ruggedized, recessed, high-torque 1 mA meter with 3.35 inch (8.51 cm) scale marked 0-1000 counts per minute and 0-2.0 kilovolts, with 'bat ok' band

RECORDER OUTPUT: 1 volt full scale into 1 megohm load

CONTROLS: Seven position rotary switch - alarm set, bat., HV, X1000, X100, X10, X1; rotary fast/slow response switch

SINGLE CHANNEL ANALYZER MODES: Selected by front-panel control as follows:
Channel 1: Accepts signals within the analyzer window only
Channel 2: Accepts signals above the analyzer window only
Out: Accepts all signals above the lower level discriminator

LOWER LEVEL DISCRIMINATOR: Adjustable from < 0.1 to 1 V via a turns counting dial

WINDOW: Adjustable from 0 to 1 V above the lower-level discriminator setting via a turns counting dial

PULSE-PAIR RESOLUTION: Typically 10 usec or less

2.0 ANALOG (RATEMETER) SECTION

There are 4 control switches associated with this section. The functions of these controls can be observed on the analog meter.

2.1 RATEMETER SWITCH

This switch is the heart of the analog controls. It has 7 functions:

a) Alarm Set. In this position, the level at which the alarm will enable on all 4 ranges is displayed on the analog meter. This level is user adjustable from 10% to 130% of full scale via the alarm set potentiometer found immediately to the left of the words "Alarm Set". A small, flatblade screwdriver is required for the adjustment.

b) Bat. The condition of the internal batteries can be observed when this function is selected. A reading within the "bat. ok" checkband should be observed.

If the unit is not connected to AC power, and the meter reading is low or below the checkband, the instrument should be connected to AC power to prevent deep battery discharge.

If AC power is present and the reading is below the checkband, the unit should be serviced by qualified personnel.

c) HV. In this position, the detector high voltage is directly displayed on the lower meter scale. The high voltage can be varied from 400 to 2000V by using the 10-turn HV Adjust control.

Clockwise rotation of the control increases the HV. The HV Adjust control dial is calibrated to the HV itself. Multiply the reading on the HV Adjust dial by 2 to get the HV setting.

A locking arm on the left side of the HV Adjust control prevents rotation of the control. This locking arm must be lifted to turn the dial.

d) X1000 through X1. These 4 positions are the 4 counting ranges of the instrument. When taking a reading, be sure to multiply the meter reading by the counting range setting.

2.2 AUDIO SWITCH

The audio switch controls the functions of the internally mounted speaker. In the "off" position, the speaker is turned off.

In the "pulse" position, the speaker provides an audible "click" for each detector event.

In the "alarm" position, the speaker produces a loud tone whenever the alarm set level is exceeded on any of the 4 counting ranges.

2.3 RESPONSE SWITCH

This switch controls the response time on the 4 counting ranges. The fast/slow response time has been optimized for each range, as follows:

Range	Response Time	
	Fast	Slow
X1	8 sec.	15 sec.
X10	1 sec.	5 sec.
X100	<1 sec.	2 sec.
X1000	<1 sec.	1 sec.

2.4 ANALYZER CONTROLS

a) Analyzer Switch. This switch works together with the threshold and window controls to form a single channel analyzer with 3 modes of operation.

Channel 1: Accepts signals within the analyzer window only.

Out: Accepts all signals above the threshold setting.
Channel 2: Accepts signals above the analyzer window only.

b) The threshold control is adjustable to accept detector signals from < 0.1 to 1V. The threshold setting determines the lowest level of pulse heights counted by the instrument in the "Channel 1" and "Out" modes. In conjunction with the HV Adjust control, it determines the lower-energy cutoff of scintillation probes.

Clockwise rotation raises the discrimination level. Do not rotate this control fully counter-clockwise, or electronic noise may be counted by the unit.

c) The window control is adjustable from 0 to 1V above the threshold. The window control varies the band of pulses (i.e...the lower and upper limits of pulse heights) counted in the "Channel 1" mode, and also functions as the discriminator in the "Channel 2" mode.

Clockwise rotation widens he window (Channel 1) or raises the Channel 2 discriminator level.

d) The threshold and window controls are 10-turn devices. Like the HV Adjust control, the threshold and window dials can be locked by pushing down on the arm located to the left side of each control. Lift the arms up before attempting to turn the knobs.

2.5 DETECTOR CONNECTION

The detector connector is an MHV-type connector. Always turn the power switch off before removing or connecting a detector.

2.6 STRIP CHART RECORDER OUTPUT (REAR PANEL)

The analog signal observed on the meter is also present at the 9-pin "D" connector on the rear panel. Pin 1 of the connector is the signal, and Pin 6 is ground. An adjustment for the amplitude of the signal is located above the "D" connector. It is a single-turn device which can be adjusted with a flat-blade screwdriver. The output can be adjusted from 0 to about 1.3V for a full-scale reading. The output can drive a 1 megohm load.

2.7 EXTERNAL ALARM OUTPUT (REAR PANEL)

This signal is available at the 9-pin "D" connector on the rear panel. Pin 4 is the "+" side and Pin 5 is the "-" side. Whenever an alarm condition occurs, a driving current is available to enable an external alarming device. The output can source up to 25 mA at 5 VDC.

Note: The alarm signal available at this output is independent of the audio control switch alarm setting.

3.0 SCALER OPERATION

Digital (Scaler) Section

There are one rotary and 7 pushbutton switches controlling this section. The 7-digit LED display shows all data associated with the use of these controls.

The scaler rotary switch is used to select one of 4 basic modes. The pushbuttons control various functions in each mode as noted.

3.1 MANUAL MODE

In this mode, the unit is used as a continuous event counter, with elapsed time and average CPM also available to the user. The 7-digit display should read "00" and the annunciator lights "elapsed" and "counts" should be illuminated when this mode is selected.

To begin counting, press the pushbutton switch labeled "count". The pushbutton will illuminate, indicating that the unit is counting. Counting in the manual mode is indefinite. The only way to stop counting is to press either the "hold" or "reset" pushbuttons, or to turn the scaler rotary switch to a different mode.

To stop counting but not lose the data on the display, simply press the "hold" pushbutton. The "hold" pushbutton will now illuminate and the "count" pushbutton light will turn off, indicating a hold condition. The elapsed counts are now frozen on the display.

When the "hold" pushbutton is pressed a second time, the elapsed time of the count will be displayed. The annunciators "elapsed" and "minutes" will be illuminated.

To display the average counts per minute, press the hold button a third time. The display will show the average CPM to 4 significant figures, and the annunciators "counts" and "minutes" will be illuminated.

In fact, the hold button acts like a 3-position toggle switch: it alternates among elapsed counts, elapsed minutes, and average CPM in that order each time it is pressed.

To resume counting, press the "count" pushbutton. It will illuminate, and the "hold" pushbutton light will turn off. The counter will pick up where it had left off when the "hold" pushbutton was pressed.

To terminate the present data, press the "reset" pushbutton switch. This is a destructive reset -- all data is erased, and the 7-digit display will read "00". The annunciators "elapsed" and "counts" will be illuminated.

3.2 PRESET COUNT X1K MODE

In this mode, the unit is used as a counter that will count until a preset number of counts has been reached. When this mode is selected, the 7-digit display will read "0.0" (on power-up) or the last preset count entered (if the present count mode has been used since power-up). The annunciators "preset" and "counts" will be illuminated.

The unit will not count if the preset count is 0.0 counts. The preset count is entered by using the 4 "set" pushbuttons. Each pushbutton increments the digit immediately above it by one. If a "set" pushbutton is kept depressed, it will continuously increment the digit above it at a rate of about 3 times a second.

The preset count has a range of 100 to 999,900 counts in 100 count increments. To reset the preset count to 0.0, press the "reset" switch.

Once the preset count has been determined, counting can begin. Press the pushbutton switch labeled "count". It will illuminate, as will the annunciators "elapsed" and "counts". The unit will count until the preset count is reached. At this point, the unit will automatically hold the elapsed counts (which will be the same as the preset counts). The count pushbutton light will turn off, and the hold switch will illuminate.

To interrupt counting but not lose the data on the display, simply press the "hold" pushbutton. The "hold" pushbutton will now illuminate and the "count" pushbutton light will turn off, indicating a hold condition.

The elapsed counts are now frozen on the display. When the "hold" pushbutton is pressed a second time, the elapsed time of the count will be displayed. The annunciators "elapsed" and "minutes" will be illuminated.

To display the preset counts, press the "hold" pushbutton a third time. The annunciators "preset" and "counts" will be illuminated, and the 7-digit display will show the preset count.

To display the average counts per minute, press the hold button a fourth time. The display will show the average CPM to 4 significant figures, and the annuniciators "counts" and "minutes" will be illuminated.

In fact, the hold button acts like a 4-position toggle switch: it alternates among elapsed counts, elapsed minutes, preset counts, and average CPM in that order each time it is pressed.

To resume counting, push the "count" pushbutton. It will illuminate, and the "hold" pushbutton light will turn off. Counting will resume at the point where counting was stopped when the "hold" pushbutton was pressed. If the preset count has been reached, counting cannot be restarted by pressing the "count" pushbutton.

To terminate the present data, or to start over after a preset count has been reached, press the "reset" switch. This is a destructive reset -- all data (except the preset count) is erased. The 7-digit display will show the preset count and the "preset" and "counts" annunciators will be lit.

If reset is pressed a second time, the preset count will also be erased.

3.3 PRESET TIME MODE

In this mode, the unit is used as a counter that will count until a preset time has been reached. When this mode is selected, "0.0" (on power-up) or the last preset time entered will be displayed (if the preset time mode has been used since power-up). The annunciators "preset" and "minutes" will be illuminated.

The unit will not count if the preset time is 0.0 minutes. The preset time is entered by using the 4 "set" pushbuttons. Each pushbutton increments the digit immediately above it by one. If a "set" pushbutton is kept depressed, it will continuously increment the digit above it at a rate of about 3 times a second.

The preset time has a range of .1 to 999.9 minutes in .1 minute increments. To reset the preset time to 0.0, press the "reset" switch.

Once the preset time has been determined, counting can begin. Press the pushbutton labeled "count". It will illuminate, as will the annunciators "elapsed" and "counts". The unit will count until the preset time is reached. At this point, the unit will automatically hold the elapsed counts. The count pushbutton light will turn off, and the hold pushbutton will illuminate.

To interrupt counting but not lose the data on the display, simply press the "hold" pushbutton. The "hold" pushbutton will now illuminate and the "count" pushbutton light will turn off, indicating a hold condition. The elapsed counts are now frozen on the display.

When the "hold" pushbutton is pressed a second time, the elapsed time of the count will be displayed. The annunciators "elapsed" and "minutes" will be illuminated.

To display the preset time, push the "hold" pushbutton a third time. The annunciators "preset" and "minutes" will be illuminated, and the 7-digit display will show the preset time.

To display the average counts per minute, press the hold button a fourth time. The display will show the average CPM to 4 significant figures, and the annunciators "counts" and "minutes" will be illuminated.

In fact, the hold button acts like a 4-position toggle switch: it alternates among elapsed counts, elapsed minutes, preset time, and average CPM in that order each time is is pressed.

To resume counting, push the "count" switch. It will illuminate, and the "hold" switch light will turn off. The counter will resume at the point where counting was stopped when the "hold" switch was pressed. If the preset time has been reached, the counter cannot be restarted by pressing the "count" switch.

To terminate the present data, or to start over after a preset time has been reached, press the "reset" switch. This is a destructive reset -- all data (except the preset time) is erased. The 7-digit display will show the preset time and the "preset" and "minutes" annunciators will be illuminated. To erase the preset time, press the reset pushbutton a second time.

3.4 TEST MODE

In this mode, the unit performs a self-test on all scaler controls. This test ensures that all switches, digits, annunciators, and timers for the scaler are operating properly.

When the "test" mode is entered, the display will read "8888888" for about 2 seconds. Next, the "count" and "hold" pushbutton lights, the "preset", "elapsed", "counts", and "minutes" annunciators, and two decimal points on the 7-digit display will be illuminated for 2 seconds. The user should watch for missing lights or missing segments on the display during this part of the test.

The test continues as the number "01" is displayed. This indicates that the user is to depress the rightmost "set" pushbutton switch. If the switch is good, the display will read "02". This also indicates that the user is to depress the second from the right "set" pushbutton switch. This sequence will be repeated all the way through the count switch ("07").

The "count" and "hold" pushbutton lights will be illuminated when the user is required to press them. They should turn off when pressed. This test informs the user that all pushbuttons are operating properly.

After the "count" pushbutton is pressed, the 7-digit display will reset to "00", and the "count" switch will flash at a rate of about 4 times a second. This prompts the user to start up the timer test by depressing the "count" pushbutton switch. The "elapsed" and "minutes" annunciators will illuminate, and the 7-digit display will become a 1 minute timer, incrementing in .01 of a minute. The user should compare the scaler timebase to a known reference.

The timer will then count to 1.00 minutes and pause. Again, the "count" pushbutton will flash at about 4 times a second. If desired, this pushbutton can be depressed to start the self-test over.

3.5 NOTES ON SCALER OPERATION

a) Whenever the mode is changed via the "scaler" rotary switch, the unit automatically engages the mode indicated by the switch position. Any data (except preset time and preset count) accumulated in the present scaler mode is lost. The new mode will be engaged immediately even if the unit is in the middle of a count.

b) The "hold" and "reset" pushbutton switches have been debounced. This means that these switches must be first depressed then released in order for them to function a second time. This helps prevent accidental loss of data.

c) In order for the scaler to count, the ratemeter switch must be in one of the 4 counting ranges (X1000 through X1).

d) The analyzer determines what is counted by the scaler. With the analyzer in "Channel 1" mode, the scaler will count only pulses within the analyzer window. Thus, the scaler can be used as a powerful single-channel ana-lyzer.

4.0 POWER REQUIREMENTS

The labtech can be operated from 2 power sources: AC line or batteries. Battery power will automatically engage when AC power is interrupted.

4.1 AC POWER

The AC cord receptacle/fuse holder can be found on the rear panel of the labtech. It will accept a standard CSA North American power cord (supplied). Also on the rear panel is a 110V/220V voltage selector switch. This switch can be easily changed with a small, flat-bladed screwdriver. The arrow indicates the voltage setting.

4.2 FUSE

Fuse type: BUSS GMA-1/4 or equivalent

To check or replace a fuse, remove the power cord from the AC cord receptacle. Gently pry out the fuse holder with a small, flat-bladed screwdriver by rocking the screwdriver back and forth along the bottom edge of the holder. The holder contains 2 fuses. The rear fuse is the active fuse; the front is a spare. The fuseholder snaps into place by pressing on it.

4.3 BATTERY POWER

Battery type: (2) 6V, 1 amp-hour
sealed rechargeable
gelled cells

With fully charged batteries, the labtech will provde 8 hours of continuous service. The circuitry of the labtech has been designed to get the longest life possible from the rechargeable batteries. The following information and suggestions will help ensure that the user will get optimum service from the batteries:

a) Recharging occurs when the unit is connected to AC power via the power cord. The front panel power switch can be in the "on" or "off" position as charging will occur in either mode.

The circuitry has been designed to prevent overcharging from continuous AC usage. Discharged batteries require approximately 16 hours to recharge.

b) When a check on the battery condition (accomplished by rotating the ratemeter switch to the "bat." position) results in a reading at the bottom of the "bat. ok" checkband or lower on the meter, it is recommended that the unit be connected to AC power as soon as possible. Continually deep-discharging gelled cell batteries can shorten their useful life.

c) The internal batteries also serve as a power failure backup. If a power failure occurs while the unit is in operation, a smooth transition occurs between the AC line power and the battery power.

4.4 BATTERY REPLACEMENT

Gelled cell batteries can provide 2-4 years service under normal use. A battery which fails to hold a sufficient charge should be replaced. It is best to replace both batteries of the pair since the life expectancy of each is about the same.

Procedure:

1) Turn off and unplug the instrument.
2) Remove the top cover of the labtech by removing the 4 screws (2 on each side) that secure it.
3) Remove the bracket that secures the batteries to the side of the case using a 1/4" nutdriver.
4) Disconnect the slide-on terminals from the batteries. Remove old batteries.
5) Install new batteries. Connect the red wire to the "+" terminal of one battery, and the black wire to the "-" terminal of the other. Connect the yellow wire with 2 slip-on connectors to the remaining 2 battery terminals.
6) Reverse steps 2) and 3) to finish the installation.

5.0 CIRCUIT DESCRIPTION

The Bicron labtech consists of 3 interconnected printed circuit boards. Each board incorporates different building blocks that make up a whole system.

5.1 POWER SUPPLY

This circuitry is contained on the large, main circuit board mounted in the bottom half of the instrument. Page 1 of the schematic diagram shows the circuit design.

The power supply is divided into two sections: a +14V supply which recharges the gelled cell batteries and a +5V supply which powers the rest of the instrument. The +14V supply is both voltage and current limited to provide maximum battery life.

The +14V supply is present whenever the unit is connected to AC power. It recharges the batteries in a way recommended by gelled cell battery manufacturers.

The +5V supply is enabled whenever the main power on/off switch (located on the front panel) is turned on. Both supplies are feedback regulated.

5.2 ANALOG RATEMETER

This circuitry is also found on the main circuit board. All of its controls are mounted on a circuit board immediately behind the front panel. The 2 boards are interconnected by a 28-pin ribbon cable assembly. Page 2 of the schematic diagram shows the circuit design.

There are several components associated with the ratemeter circuitry:

-A feedback-regulated, electronically stabilized high voltage supply for the detector potential. Additional circuitry provides HV readout on the meter scale.

-A linear charge pump ratemeter which converts the detector pulses to a count rate reading on the calibrated meter scale. Also included is automatic and manual time constant selection. All circuitry is temperature compensated.

-An audio section for individual pulse counting and adjustable alarm.

-A single channel pulse-height analyzer with three operating modes.

5.3 DIGITAL SCALER

This circuitry is contained on a second circuit board behind the front panel. All of its controls are mounted on the same board as the analog ratemeter's controls. The 2 boards are interconnected by two 24 pin header/top entry connectors. Page 3 of the schematic diagram shows the circuit design.

At the heart of the digital circuitry is the popular 8085 microprocessor. A CMOS version is used to conserve battery power. It controls the operation of the scaler by:

-monitoring the scaler rotary switch.
-monitoring all pushbutton switches.
-controlling all annunciator lights.
-controlling the 7-digit LED display.
-controlling the internal timer.
-maintaining all data in memory.

The system contains 8K of ROM, 1/4K of RAM, and employs 22 I/O control lines as well as 1 programmable timer.

6.0 CALIBRATION

The instrument is calibrated electronically using a variable frequency pulse generator. The calibration pots are located on the rear panel of the instrument.

A detailed calibration procedure is part of the QC Acceptance Procedure found elsewhere in this manual. Recalibration is required after servicing and at the regular intervals which may be specified by appropriate regulatory agencies.

BICRON QC ACCEPTANCE PROCEDURE NUMBER 1031930

MODEL: LABTECH^{TM}

WARNING: This procedure should be performed only by qualified personnel since AC line voltage is present inside the unit.

1. Remove the top cover of the instrument. Perform a visual inspection of the finished product.

2. Remove the fuseholder from the rear panel. Install two each Buss GMA 1/4 amp (or equivalent) fuses and replace holder. Set the power voltage selector switch to 110V by lining up the arrow on the switch with the number "110".

3. Disconnect the 28-pin ribbon cable connector from its socket on the main board. Disconnect the red wire from the "+" terminal of the 6V battery it is connected to. (Do not allow the 28-pin ribbon cable connector or the red wire to make contact with the rest of the unit). Connect a test clip lead from either side of R68 (470K ohm resistor) on the main board to ground. Inspect all AC power wiring between the rear panel and the main PC board. Connect the unit to AC power via the power cord connector on the rear panel. Perform the following tests and calibrations to the power supply:

    a. Turn the main power switch located on the front panel off. Connect a voltmeter between the disconnected red wire and ground. Turn the main power switch on. Adjust R3 (the 5K ohm +14V adjustment potentiometer) until the voltmeter reads 13.95 +/- 0.1V.

    b. Turn the main power switch off. Connect a fused ammeter between the disconnected red wire and the battery terminal which contains a black wire from the main board. Turn the main power switch back on. A reading of 110 mA +/- 20% should be observed. Disconnect the ammeter when finished.

    c. Leave the main power switch on. Connect a voltmeter from the +5V supply to ground. Adjust R11 (the 5K ohm +5V adjustment potentiometer) until the voltmeter reads 5.00 +/- .1V.

    d. Turn the main power switch off. The +5V supply should discharge to near 0V. Now connect the voltmeter again to the +14V supply. A reading approximately .2 - .5V higher than the calibrated value should be noted. This is normal and is due to the fact that the batteries have been removed from the circuit. The purpose of this test is to observe that the +14V is present regardless of the state of the main power switch.

    e. Remove all test equipment and clip leads. Reconnect the 28-pin ribbon cable connector to its main board socket, and reconnect the red wire to the "+" battery terminal. Turn the main power switch back on. Some annunciator lights should illuminate, and the 7-digit

LED display should also illuminate. This test checks to see that +5V is reaching the circuit boards mounted to the front panel.

f. Leave the main power switch on. Remove and reconnect the AC power cord from the unit a few times. After doing this, keep the AC power cord disconnected. Rotate the scaler rotary switch and observe that the annunciator lights change each time you turn the switch. This test is to see that the batteries automatically take over whenever the AC power is removed from the unit. NOTE: If the batteries are discharged, this test may fail. Recharge the batteries overnight by connecting the unit to AC power, and then repeat the test.

4. If the batteries have a sufficient charge, leave the AC power cord disconnected. Perform the following tests and calibrations to the analog ratemeter section:

   a. Turn the main power switch off. Mechanically zero the analog meter via the zero adjustment screw located immediately above the main power switch.

   b. Turn the main power switch on. Turn the ratemeter control switch to the "X1000" position. Connect a voltmeter between pins 1 and 6 on the 9-pin "D" connector located on the rear panel. With a flat-bladed screwdriver, turn the recorder full-scale adjustment potentiometer located on the rear panel fully clockwise. Adjust R45 (50K ohm zero potentiometer) until the voltmeter reads 1.0 + 2.5/-1.0 mVDC.

   c. Turn the ratemeter control switch to the "HV" position. Connect a high voltage measuring device with an impedance greater than or equal to 1000 megohms between the detector connector center pin on the front panel and ground. Turn the HV adjust control on the front panel until the dial reads 500. (Note: If the HV adjust control will not turn, lift up the locking arm located on the left side of the knob). Adjust R71 (50K ohm HV calibration potentiometer) until the high voltage measuring device reads 1000 VDC +/- 3%.

   d. Leave the ratemeter control switch in the "HV" position. Adjust R43 (500 ohm span potentiometer) until the analog meter on the front panel reads 1.0 kV on the lower scale. To test linearity, turn the HV adjust control until the dial reads 1000 (fully clockwise). The analog meter should read 2.0 kV +/- 5%. Turn the HV adjust control until the dial reads 200. The analog meter should read 0.4 kV +/- 5%.

   e. Turn the ratemeter control switch to the "bat." position. For fully charged batteries a meter reading near full scale should be observed. NOTE: If the batteries are discharged, this test may fail. Recharge the batteries overnight by connecting the unit to AC power, and then repeat the test.

   f. Turn the ratemeter control switch to the "X1000" position. Turn the response switch to the "slow" position. Turn the analyzer switch to the "out" position. Turn the audio switch to the "alarm" position.

Adjust the alarm set potentiometer on the front panel until it points around the 12 o'clock position. Connect a variable frequency pulse generator between the test point on the main board and ground. The test point is located above D7 and D8, and to the right of U3, an MC3302BCPDS integrated circuit, on the main printed circuit board. Slowly increase the frequency of the pulse generator until the speaker indicates an alarm condition. Carefully note the exact scale reading at which the alarm condition occurs. Turn the ratemeter control switch to the "alarm set" position. Adjust R53 (50K ohm alarm set calibration potentiometer) until the meter reading is the same as the one noted above. To test linearity, adjust the alarm set potentiometer on the front panel until the analog meter indicates full scale. Turn the ratemeter control switch to the "X1000" position, and increase the frequency of the pulse generator until an alarm condition occurs. Note the analog meter reading. It should be within 5% of full scale. Repeat this last test for alarm settings of 50% and 20% of full scale on the analog meter. Each result should yield an alarm condition within 5% of the alarm set point.

g. Turn the ratemeter control switch to the "alarm set" position. Connect a voltmeter between pins 1 and 6 on the 9-pin "D" connector located on the rear panel. Adjust the alarm set potentiometer on the front panel until a reading of full scale is observed. Turn the recorder full-scale adjustment potentiometer on the rear panel fully clockwise. The voltmeter should read 1.30 +/- .15V. Adjust the recorder full-scale potentiometer until the voltmeter reads 1.00 +/- .05V. To test the linearity of the recorder output, turn the alarm set potentiometer on the front panel to read 70% of full scale on the analog meter. The voltmeter should read .700V +/- 5%. Repeat this test for 30% of full scale. The voltmeter should read .300V +/- 5%. Leave both the recorder full scale adjustment and alarm set potentiometer at these settings.

h. Turn the control switch to the "X1000" position. Connect a voltmeter between pins 4 and 5 on the 9-pin "D" connector located on the rear panel. Connect a 1K ohm resistor across these two pins. Turn the audio switch to the "alarm" position. Increase the frequency generator until an alarm condition occurs. The voltmeter should read 5.0V +/- 5%. Decrease the frequency generator until the alarm condition ceases to exist. The voltmeter should read near 0V.

5. Perform a CPM calibration, as follows:

   a. Turn the response switch to the "slow" position. Turn the audio switch to the "off" position. Turn the analyzer switch to the "out" position. Turn the ratemeter control switch to the "X1000" position.

   b. Reconnect the variable frequency pulse generator between the test point and ground. Adjust the frequency of the generator to the value required to calibrate the unit at 80% of full scale on the analog meter. (Value listed in Table T-1).

   c. Adjust R37 (the 5K ohm X1000 calibration potentiometer) until the analog meter reads 80% of full scale.

d. Readjust the frequency of generator to the value required to calibrate at 20% of full scale on the analog meter (Value also listed in Table T-1).

e. Note the analog meter readings from Steps c and d on a Certificate of Calibration.

f. Similarly, calibrate the X100 range, using R35 (the 50K ohm X100 calibration potentiometer); the X10 range, using R33 (the 500K ohm X10 calibration potentiometer); and the X1 range, using R31 (the 5 megohm X1 calibration potentiometer).

g. Leave the pulse generator connected when calibration is complete.

TABLE T-1

Range	Pulse Generator Output (Hz)	Simulated CPM	Acceptable Meter Reading (CPM)
X1000(80%)	13,330 Hz	800,000	720,000 - 880,000
X1000(20%)	3,330 Hz	200,000	180,000 - 220,000
X100(80%)	1,330 Hz	80,000	72,000 - 88,000
X100(20%)	333 Hz	20,000	18,000 - 22,000
X10(80%)	133 Hz	8,000	7,200 - 8,800
X10(20%)	33.3 Hz	2,000	1,800 - 2,200
X1(80%)	13.3 Hz	800	720 - 880
X1(20%)	3.3 Hz	200	180 - 220

Note: The values in this table may not correspond to those for other Bicron or competitive models.

6. Turn the response switch to the "fast" position and the ratemeter control switch to the "X1000" position. Vary the frequency of the pulse generator and switch between "fast" and "slow" to check the operation of the response switch. Repeat the test for the X100, X10 and X1 positions. Leave the pulse generator connected.

7. Test the audio circuit, as follows:

   a. Turn the audio switch to the "on" position and check to see that the audio functions on all 4 counting ranges (X1000 through X1) using the pulse generator. The audio should be silent when the ratemeter control switch is in the "alarm set", "bat." and "HV" positions.

   b. Turn the ratemeter control switch to the "alarm set" position, and set the analog meter to alarm at full scale with the alarm set potentiometer. Turn the audio switch to the "alarm" position. Using the pulse generator, observe that the speaker alarms at full scale on all 4 counting ranges (X1000 through X1).

8. Test the analyzer circuit, as follows:

   a. Set the threshold control dial to 100. Set the window control dial to 300. (Note: If either of the controls will not turn, lift up the locking arm located on the left side of either control). Turn the analyzer control switch to the "out" position.

   b. Connect a variable amplitude, variable frequency, negative-going pulse generator between the test point and ground. Turn the ratemeter to the "X1000" or "X100" range, and adjust the frequency of the pulse generator until a usable reading (around 50% of full scale on the analog meter) is observed. Note the value of the reading. This frequency will remain constant throughout this test.

   c. Decrease the amplitude of the pulse generator to near 0V. Turn the analyzer switch to the "Channel 1" position. Slowly increase the amplitude of the pulse generator until the reading noted above is observed on the analog meter. This should occur suddenly. The pulse generator's amplitude has just exceeded the threshold control setting at this point. Turn the analyzer control switch to the "out" position. The same analog meter reading should be observed. Turn the analyzer control switch to the "Channel 2" position. The analog meter should read near zero. Return the analyzer switch to the "Channel 1" position.

   d. Again slowly increase the amplitude of the pulse generator until the analog meter reads near zero. This also should occur suddenly. The pulse generator's amplitude has just exceeded the window control setting at this point. Turn the analyzer switch to the "Channel 2" position. The analog meter reading should increase to the reference value noted at the beginning of the test.

9. Test the scaler section as follows:

   a. Connect a frequency counter between pin 37 of U17, an M80C85A integrated circuit, and ground. A frequency of 3.000 MHz +/- 0.05% should be observed.

   b. Connect a variable frequency pulse generator between the test point and ground. Turn the ratemeter control switch to the "X1000" position. Turn the analyzer control switch to the "out" position. Turn the audio control switch to the "off" position. Set the frequency of the pulse generator so that a reading of full scale (1,000,000 CPM) is observed on the analog meter.

   c. Turn the scaler control switch to the preset time position. Set the preset time for 1.0 minutes, and start the counter. (Note: Refer to the section that explains the use of the scaler, found elsewhere in this manual, before performing this test). When the preset time has been reached, the reading on the 7-digit LED display should be 1,000,000 CPM +/- 10%.

d. Turn the scaler control switch to the "manual" position. Verify that this mode operates correctly by following the instructions for the use of the manual position, found elsewhere in this manual. Repeat for the "preset count" and "test" modes.

10. Attach a probe to the unit's detector connector, observing the proper HV precautions for the probe. Place the probe near an appropriate check source and turn the ratemeter control switch to the "X1000" position. A meter reading should be observed. Repeat this test for the "X100", "X10", and "X1" ranges.

11. If applicable, test to ensure that any options in the unit operate correctly (refer to the appropriate manual sections for the operation of the options).

12. Turn the instrument off and remove the probe and all test equipment. Replace the top cover. Complete, date and sign a Certificate of Calibration.

SPARE PARTS LIST
BICRON labtech

SCHEMATIC SYMBOL	DESCRIPTION	PART NO
	Main PC Board Assembly	1031010
C1	Capacitor, 4700 uF, 25 V elec.	9224781
C2	Capacitor, 33 uF, 16 V tan.	9233362
C3,C10	Capacitor, 150 pF, Ceramic	9201511
C4,C5,C6,C13,C30	Capacitor, 33 uF, 10 V tan.	9233361
C8,C28,C29	Capacitor, .001 uF, 3 kV cer.	9201022
C9	Capacitor, .001 uF, Film	9211021
C11,C14,C33	Capacitor, .01 uF, Film	9211031
C12	Capacitor, .0033 uF,Film	9213321
C16,C18,C22,C27	Capacitor, .22 uF, Film	9212241
C17,C21,C24,C31	Capacitor, .047 uF, Film	9214731
C19	Capacitor, 1 uF, 10 V tan.	9231051
C20	Capacitor, 2.2 uF, 10 V tan.	9232251
C23	Capacitor, 200 pF, N750 cer.	9202011
C25,C26	Capacitor, .01 uF, 3 kV cer.	9201032
C32	Capacitor, 0.1 uF, Film	9211041
D1-D5	Diode, 1N4001	9600003
D6-D13,D16-D23	Diode, 1N4148	9600004
D14,D15	Rectifier, 2 kV PIV	9600001
L1	Inductor, 500 uH	9500002
Q1,Q3,Q5,Q8	Transistor, 2N4124	9610001
Q2,Q7	VMOS FET, VN10KMA	9610003
Q4	Transistor, 2N4037	9610004
Q6	Transistor, 2N4126	9610002
R1,R16,R19,R23,R27, R28,R72	Resistor, 10k, 1/4w, 5%	8110024
R2,R10	Resistor, 240 ohm, 1/4w, 5%	8124004
R3,R11	Trimpot, 5k	9395023
R4,R12	Resistor, 100 ohm, 1/4w, 5%	8110004
R5	Resistor, 6.2 ohm, 1/4w, 5%	8106284
R6,R39,R46,R55,R56, R57	Resistor, 1 meg, 1/4w, 5%	8110044
R7,R24,R26,R40,R65	Resistor, 100k, 1/4w, 5%	8110034
R8	Resistor, 47 ohm, 1/4w, 5%	8104704
R9	Resistor, .22 ohm, 1w, 10%	8800281
R13,R29,R62,R64	Resistor, 47k, 1/4w, 5%	8147024
R20,R21	Resistor, 4.7k, 1/4w, 5%	8147014
R22	Resistor, 10k, 1/4w, 1%	8510024
R25	Resistor, 274k, 1/4w, 1%	8527434
R30	Resistor, 10 meg, 1/4w, 1%	8510051
R31	Trimpot, 5 meg	9395051
R32,R52	Resistor, 1 meg, 1/4w, 1%	8510044
R33	Trimpot, 500k	9395041
R34	Resistor, 100k, 1/4w, 1%	8510034

R35,R45	Trimpot,	50k		9395031
R36	Resistor,	10k,	1/4w, 1%	8510024
R37	Trimpot,	5k		9395021
R38,R68	Resistor,	470k,	1/4w, 5%	8147034
R42,R47	Resistor,	4.99k,	1/4w, 1%	8549914
R43	Trimpot,	500 ohm		9395011
R44	Resistor,	249 ohm,	1/4w, 1%	8524904
R48	Resistor,	750k,	1/4w, 1%	8575034
R53	Trimpot,	50k		9395032
R54,R60	Resistor,	49.9k,	1/4w, 1%	8549924
R58	Resistor,	1000 meg,	1%	8810071
R59	Resistor,	499k,	1/4w, 1%	8549934
R61	Resistor,	150k,	1/4w, 5%	8115034
R66	Resistor,	560 ohm,	1/4w, 5%	8156004
R67	Resistor,	2.7k,	1/4w, 5%	8127014
R73	Resistor,	200k,	1/4w, 1%	8520034
RN1	Res. Network,	7 x 220k		8822031
T1	Transformer,	PSD-428		9500003
T2	Transformer,	M8149		9500001
U1,U2	Voltage Regulator IC,	LM317T		9640006
U3	Int. Ckt.,	MC3302PDS		9640002
U4	Int. Ckt.,	MC14538BCPDS		9650004
U5	Int. Ckt.,	MC14093BCPDS		9650001
U6,U7	Int. Ckt.,	CA3160BEX		9640001
U8,U9	Int. Ckt.,	CD4016BEX		9650002
	Switch PC Board Assembly			1031020
C7	Capacitor,	0.1 uF,	Film	9211041
D24-D30	LED Display,	7-segment		9680001
D31-D34	LED Indicator			9680002
R14	Resistor,	10k,	1/4w, 1%	8510024
R18,R51	Resistor,	4.99k,	1/4w, 1%	8549914
R41	Resistor,	681 ohm,	1/4w, 1%	8568104
R49	Resistor,	121k,	1/4w, 1%	8512134
R50	Trimpot,	50k		9395032
R70	Resistor,	150k,	1/4w, 1%	8515034
R71	Trimpot,	50k		9395031
S1	Sounder			9720001
SW3,SW4	Switch,	Rotary,	3 pos.	9560002
SW6	Switch,	Rotary,	7 pos.	9560009
SW7	Switch,	Pushbutton, w/Red Button		9550004
SW8,SW9	Switch,	Pushbutton, with Red LED		9550003
SW10-SW13	Switch,	Pushbutton, White Button		9550005
SW14	Switch,	Rotary,	4 pos.	9560010
	Header,	24-pin		9780007
	Socket, Right Angle,	15-pin		9780008
	Ribbon Cable,	28-pin to 28-pin		9801006

Microprocessor PC Board Assembly 1031030

C34	Capacitor,	.01 uF,	Film	9211031
C35	Capacitor,	150 pF,	Ceramic	9201511
C36	Capacitor,	2.2 uF,	10 V tan.	9232251
C37,C38	Capacitor,	22 pF,	Ceramic	9202201
C39-C44	Capacitor,	33 uF,	10 V tan.	9233361
D35-D38	Diode,	1N4148		9600004
Q9-Q16	Transistor,	2N4124		9610001
R74,R75	Resistor,	100 ohm,	1/4w, 5%	8110004
R76-R78,R80,R82,R84, R86,R88,R93,R96-R99	Resistor,	4.7k,	1/4w, 5%	8147014
R79,R81,R83,R85,R87, R89	Resistor,	200 ohm,	1/4w, 5%	8120004
R90,R91	Resistor,	47k,	1/4w, 5%	8147024
R92	Resistor,	10k,	1/4w, 5%	8110024
R94	Resistor,	100k,	1/4w, 5%	8110034
R95	Resistor,	1 meg,	1/4w, 5%	8110044
R100	Resistor,	200k,	1/4w, 1%	8520034
RN2-RN4	Res. Network,	7 x 220k		8822031
U10	Display Driver/Counter IC,	ICM7208		9650006
U11,U12	Int. Ckt.,	MC14532BCPDS		9650008
U13,U21	Int. Ckt.,	MC74HC4040NDS		9650009
U14-U16	Int. Ckt.,	MC74HC00NDS		9650010
U17	Microprocessor IC,	MSM80C85ARS		9650007
U18	IO/RAM/Timer IC,	MSM81C55RS		9650011
U19	Int. Ckt.,	MC74HC343N		9650005
U20	Int. Ckt.,	MC74HC139NDS		9650012
U22	Int. Ckt.,	MC74HC04NDS		9650013
U23	Programmed EPROM,	Labtech Ver. 1.1		9655001
X1	Crystal,	6.0000 MHz,	MP-1	9729001
	Connector,	24-pin		9780001
	Connector,	20-pin		9780009

Front Panel Assembly 1031040

M1	Meter			9400026
R15,R17	Potentiometer,	5K 10-turn		9385021
R69	Potentiometer,	50K 10-turn		9385031
SW2	Switch,	Power On-Off		9550006
SW5	Switch,	Rotary,	2 pos.	9560011
	Display Window, Red			9100080
	MHV Connector			9782001
	Wiring Harness			9801007
	Spacer, 1/4 hex 6-32x1.25			9970005

	Bushing	9970006
	Bezel	9973008
	Panel Bezel	9973009
	Rear Panel Assembly	**1031050**
F1	Fuse, 1/4 A	9760001
R63	Potentiometer,20k	9382031
SW1	Switch, Voltage Selector	9550007
	Line Cord Receptacle	9760002
	Connector, 9-pin D, female	9780004
	Panel Bushing with Nut	9970012
	Upper Housing Final Ass'y	**9100094**
	Miscellaneous	
BT1,BT2	Battery, 6V, 1Ah rechargeable	9750005
	Bottom Housing, Painted	9090095
	Side Extrusion	9090097
	Cable, Probe, MHV-MHV, 36-inch	9801001
	Power Cord	9802001
	Battery Support Bracket	9850012
	Rubber Bumper	9961001
	Tip-Up Foot	9961003
	Manual, Instruction	1031900
	Spare Parts List	1031910
	Schematic Circuit Diagram	1031920
	QC Acceptance Procedure	1031930

SPARE PARTS LIST
BICRON labtech with RS-232 option

SCHEMATIC SYMBOL	DESCRIPTION	PART NO
	Main PC Board Assembly	1031012
C1	Capacitor, 4700 uF, 25 V elec.	9224781
C2	Capacitor, 33 uF, 16 V tan.	9233362
C3,C10	Capacitor, 150 pF, Ceramic	9201511
C4,C5,C6,C13,C30	Capacitor, 33 uF, 10 V tan.	9233361
C8,C28,C29	Capacitor, .001 uF, 3 kV cer.	9201022
C9	Capacitor, .001 uF, Film	9211021
C11,C14,C33	Capacitor, .01 uF, Film	9211031
C12	Capacitor, .0033 uF,Film	9213321
C16,C18,C22,C27	Capacitor, .22 uF, Film	9212241
C17,C21,C24,C31	Capacitor, .047 uF, Film	9214731
C19	Capacitor, 1 uF, 10 V tan.	9231051
C20	Capacitor, 2.2 uF, 10 V tan.	9232251
C23	Capacitor, 200 pF, N750 cer.	9202011
C25,C26	Capacitor, .01 uF, 3 kV cer.	9201032
C32	Capacitor, 0.1 uF, Film	9211041
D1-D5	Diode, 1N4001	9600003
D6-D13,D16-D23	Diode, 1N4148	9600004
D14,D15	Rectifier, 2 kV PIV	9600001
L1	Inductor, 500 uH	9500002
Q1,Q3,Q5,Q8	Transistor, 2N4124	9610001
Q2,Q7	VMOS FET, VN10KMA	9610003
Q4	Transistor, 2N4037	9610004
Q6	Transistor, 2N4126	9610002
R1,R16,R19,R23,R27, R28,R72	Resistor, 10k, 1/4w, 5%	8110024
R2,R10	Resistor, 240 ohm, 1/4w, 5%	8124004
R3,R11	Trimpot, 5k	9395023
R4,R12	Resistor, 100 ohm, 1/4w, 5%	8110004
R5	Resistor, 6.2 ohm, 1/4w, 5%	8106284
R6,R39,R46,R55,R56, R57	Resistor, 1 meg, 1/4w, 5%	8110044
R7,R24,R26,R40,R65	Resistor, 100k, 1/4w, 5%	8110034
R8	Resistor, 47 ohm, 1/4w, 5%	8104704
R9	Resistor, .22 ohm, 1w, 10%	8800281
R13,R29,R62,R64	Resistor, 47k, 1/4w, 5%	8147024
R20,R21	Resistor, 4.7k, 1/4w, 5%	8147014
R22	Resistor, 10k, 1/4w, 1%	8510024
R25	Resistor, 274k, 1/4w, 1%	8527434
R30	Resistor, 10 meg, 1/4w, 1%	8510051
R31	Trimpot, 5 meg	9395051
R32,R52	Resistor, 1 meg, 1/4w, 1%	8510044
R33	Trimpot, 500k	9395041
R34	Resistor, 100k, 1/4w, 1%	8510034

	Microprocessor PC Board Assembly			1031032
C34	Capacitor,	.01 uF,	Film	9211031
C35	Capacitor,	150 pF,	Ceramic	9201511
C36	Capacitor,	2.2 uF,	10 V tan.	9232251
C37,C38	Capacitor,	22 pF,	Ceramic	9202201
C39-C46	Capacitor,	33 uF,	10 V tan.	9233361
D35-D40	Diode,	1N4148		9600004
Q9-Q17	Transistor,	2N4124		9610001
Q18	Transistor,	2N4126		9610002
R74,R75	Resistor,	100 ohm,	1/4w, 5%	8110004
R76-R78,R80,R82,R84, R86,R88,R93,R96-R99	Resistor,	4.7k,	1/4w, 5%	8147014
R79,R81,R83,R85,R87, R89	Resistor,	200 ohm,	1/4w, 5%	8120004
R90,R91	Resistor,	47k,	1/4w, 5%	8147024
R92,R101,R104	Resistor,	10k,	1/4w, 5%	8110024
R94	Resistor,	100k,	1/4w, 5%	8110034
R95	Resistor,	1 meg,	1/4w, 5%	8110044
R100	Resistor,	200k,	1/4w, 1%	8520034
R102,R103	Resistor,	1k,	1/4w, 5%	8110014
RN2-RN4	Res. Network, 7 x 220k			8822031
U10	Display Driver/Counter IC, ICM72089650006			
U11,U12	Int. Ckt.,	MC14532BCPDS		9650008
U13,U21	Int. Ckt.,	MC74HC4040NDS		9650009
U14-U16	Int. Ckt.,	MC74HC00NDS		9650010
U17	Microprocessor IC, MSM80C85ARS			9650007
U18	IO/RAM/Timer IC, MSM81C55RS			9650011
U19	Int. Ckt.,	MC74HC343N		9650005
U20	Int. Ckt.,	MC74HC139NDS		9650012
U22	Int. Ckt.,	MC74HC04NDS		9650013
U23	Programmed EPROM, Labtech Ver. 1.29655003			
U30	Int. Ckt.,	ICL7660CPA		9640005
X1	Crystal, 6.0000 MHz, MP-1			9729001
	Connector,	24-pin		9780001
	Connector,	20-pin		9780009
	Front Panel Assembly			1031042
M1	Meter			9400026
R15,R17	Potentiometer,5K 10-turn			9385021
R69	Potentiometer,50K 10-turn			9385031
SW2	Switch,	Power On-Off		9550006
SW5	Switch,	Rotary, 2 pos.		9560011
	Display Window, Red			9100080

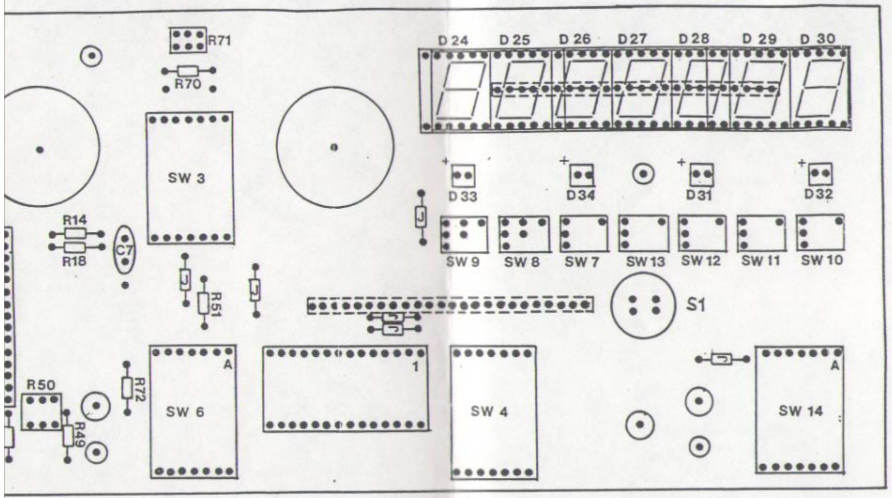
R35,R45	Trimpot, 50k	9395031
R36	Resistor, 10k, 1/4w, 1%	8510024
R37	Trimpot, 5k	9395021
R38,R68	Resistor, 470k, 1/4w, 5%	8147034
R42,R47	Resistor, 4.99k, 1/4w, 1%	8549914
R43	Trimpot, 500 ohm	9395011
R44	Resistor, 249 ohm, 1/4w, 1%	8524904
R48	Resistor, 750k, 1/4w, 1%	8575034
R53	Trimpot, 50k	9395032
R54,R60	Resistor, 49.9k, 1/4w, 1%	8549924
R58	Resistor, 1000 meg, 1%	8810071
R59	Resistor, 499k, 1/4w, 1%	8549934
R61	Resistor, 150k, 1/4w, 5%	8115034
R66	Resistor, 560 ohm, 1/4w, 5%	8156004
R67	Resistor, 2.7k, 1/4w, 5%	8127014
R73	Resistor, 200k, 1/4w, 1%	8520034
RN1	Res. Network, 7 x 220k	8822031
T1	Transformer, PSD-428	9500003
T2	Transformer, M8149	9500001
U1,U2	Voltage Regulator IC, LM317T	9640006
U3	Int. Ckt., MC3302PDS	9640002
U4	Int. Ckt., MC14538BCPDS	9650004
U5	Int. Ckt., MC14093BCPDS	9650001
U6,U7	Int. Ckt., CA3160BEX	9640001
U8,U9	Int. Ckt., CD4016BEX	9650002
	Switch PC Board Assembly	1031022

C7	Capacitor, 0.1 uF, Film	9211041
D24-D30	LED Display, 7-segment	9680001
D31-D34	LED Indicator	9680002
R14	Resistor, 10k, 1/4w, 1%	8510024
R18,R51	Resistor, 4.99k, 1/4w, 1%	8549914
R41	Resistor, 681 ohm, 1/4w, 1%	8568104
R49	Resistor, 121k, 1/4w, 1%	8512134
R50	Trimpot, 50k	9395032
R70	Resistor, 150k, 1/4w, 1%	8515034
R71	Trimpot, 50k	9395031
S1	Sounder	9720001
SW3,SW4	Switch, Rotary, 3 pos.	9560002
SW6	Switch, Rotary, 7 pos.	9560009
SW7	Switch, Pushbutton, w/Red Button	9550004
SW8,SW9	Switch, Pushbutton, with Red LED	9550003
SW10-SW13	Switch, Pushbutton, White Button	9550005
SW14	Switch, Rotary, 4 pos.	9560010
	Header, 24-pin	9780007
	Socket, Right Angle, 15-pin	9780008
	Ribbon Cable, 28-pin to 28-pin	9801006

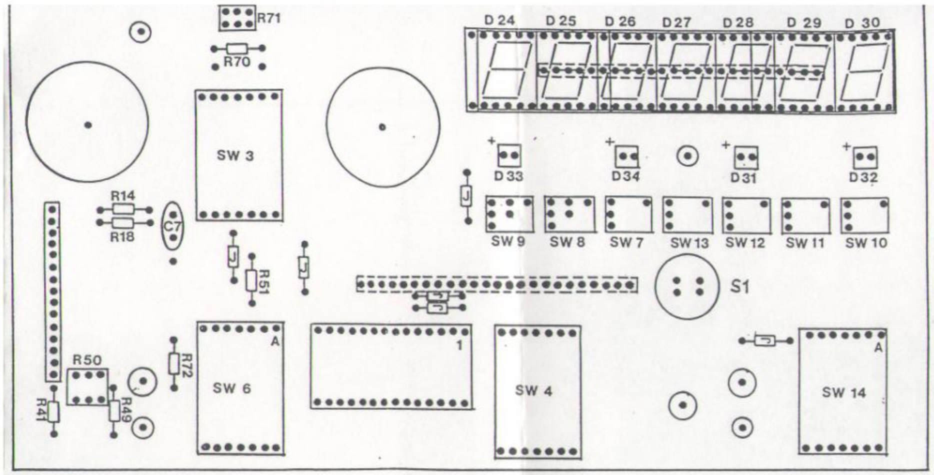
	MHV Connector	9782001
	Wiring Harness	9801007
	Spacer, 1/4 hex 6-32x1.25	9970005
	Bushing	9970006
	Bezel	9973008
	Panel Bezel	9973009
	Rear Panel Assembly	**1031052**
F1	Fuse, 1/4 A	9760001
R63	Potentiometer,20k	9382031
SW1	Switch, Voltage Selector	9550007
	Line Cord Receptacle	9760002
	Connector, 9-pin D, female	9780004
	Panel Bushing with Nut	9970012
	Upper Housing Final Ass'y	**9100094**
	Miscellaneous	
BT1,BT2	Battery, 6V, 1Ah rechargeable	9750005
	Bottom Housing, Painted	9090095
	Side Extrusion	9090097
	Cable, Probe, MHV-MHV, 36-inch	9801001
	Power Cord	9802001
	Battery Support Bracket	9850012
	Rubber Bumper	9961001
	Tip-Up Foot	9961003
	Manual, Operator's	1031902
	Spare Parts List	1031912
	Schematic Circuit Diagram	1031922
	QC Acceptance Procedure	1031930

Part No. 1031912

Issue:	Date:
Original	03/13/86



TOLERANCES UNLESS OTHERWISE SPECIFIED	SCALE: /1/	BICRON



REV.	DATE	DESCRIPTION	BY

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °
MICRO FIN. √
DE-BURR & BREAK ALL EDGES

SCALE: 1:1
DRAWN: JAR
DATE: 1-3/-86
CHECKED:
DATE:
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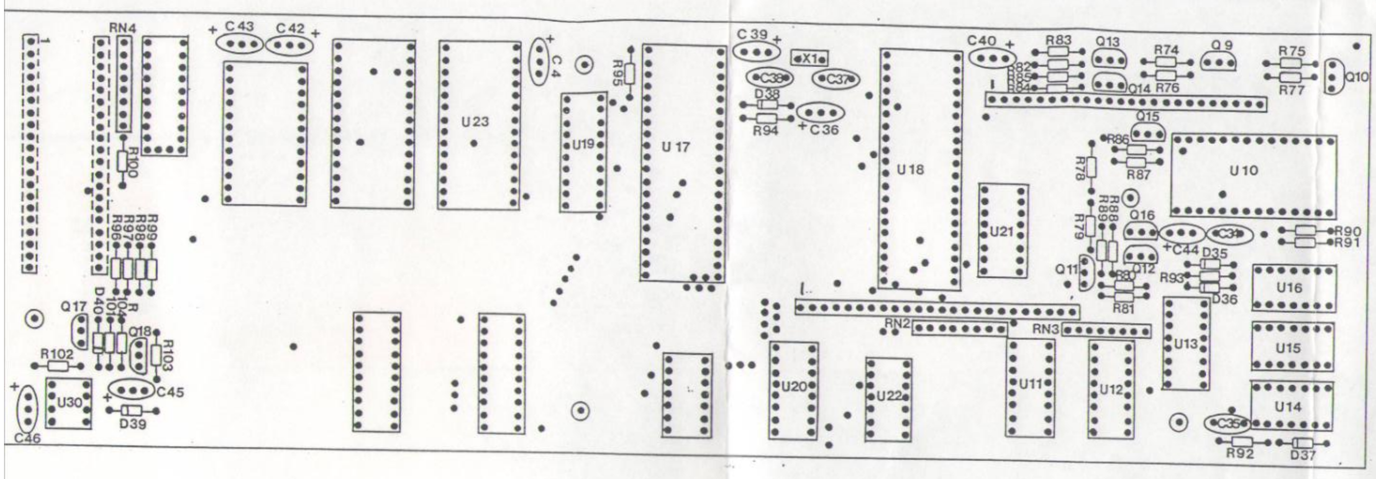
CORPORATION
NEWBURY, OHIO U.S.A.

COMPONENT LOCATIONS
LABTECH SWITCH BOARD

PROD. CODE	Dwg. Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B	1031022			



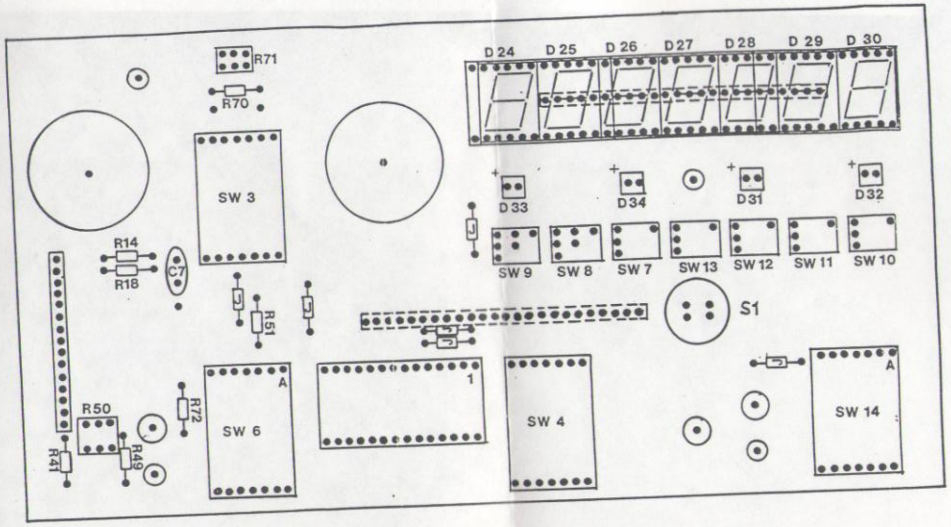
TOLERANCES UNLESS OTHERWISE SPECIFIED	SCALE: 1:1
FRAC. ±	DRAWN: JAR
.X ±	
.XX ±	DATE: 1-31-86
.XXX ±	CHECKED:
ANGLES ± °	DATE:
MICRO FIN. √	

BICRON CORPORATION
NEWBURY, OHIO U.S.A.

Component Locations

Labtech Microprocessor Boar

PROD. CODE | Dwg.Code | BASIC PART NUMBER



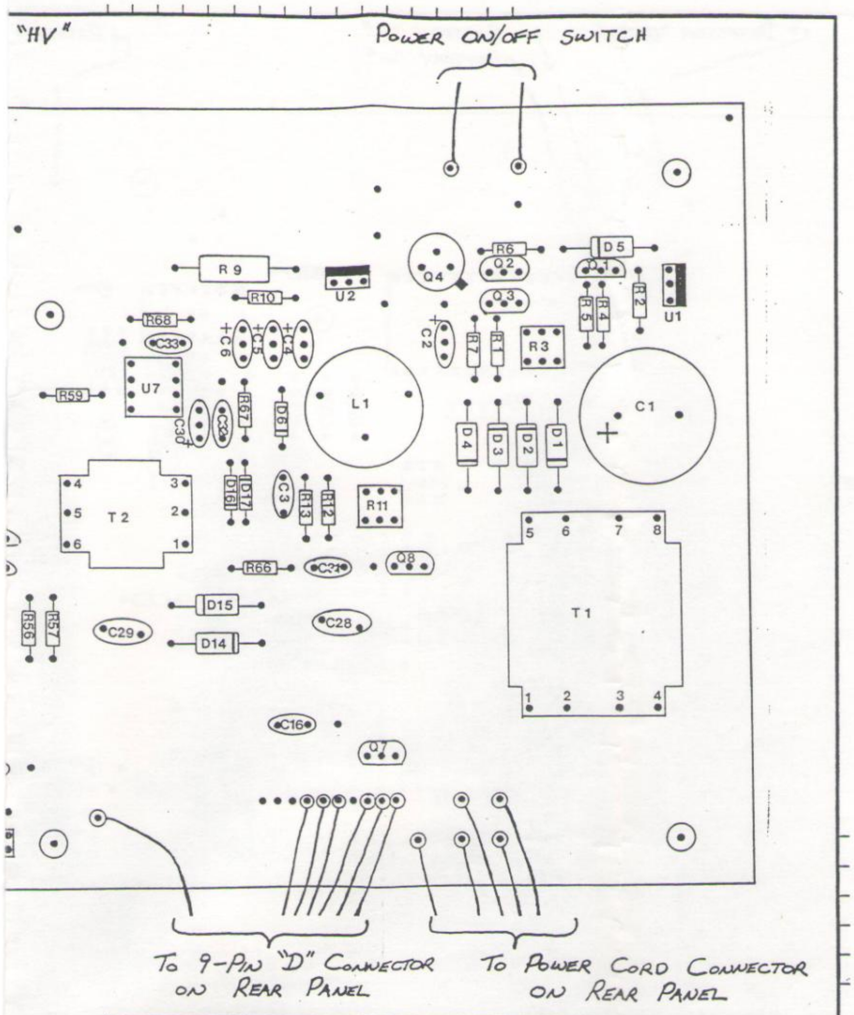
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °

SCALE: 1:1
DRAWN: JAR
DATE: 1-31-86
CHECKED:
DATE:

BICRON CORPORATION
NEWBURY, OHIO U.S.A.

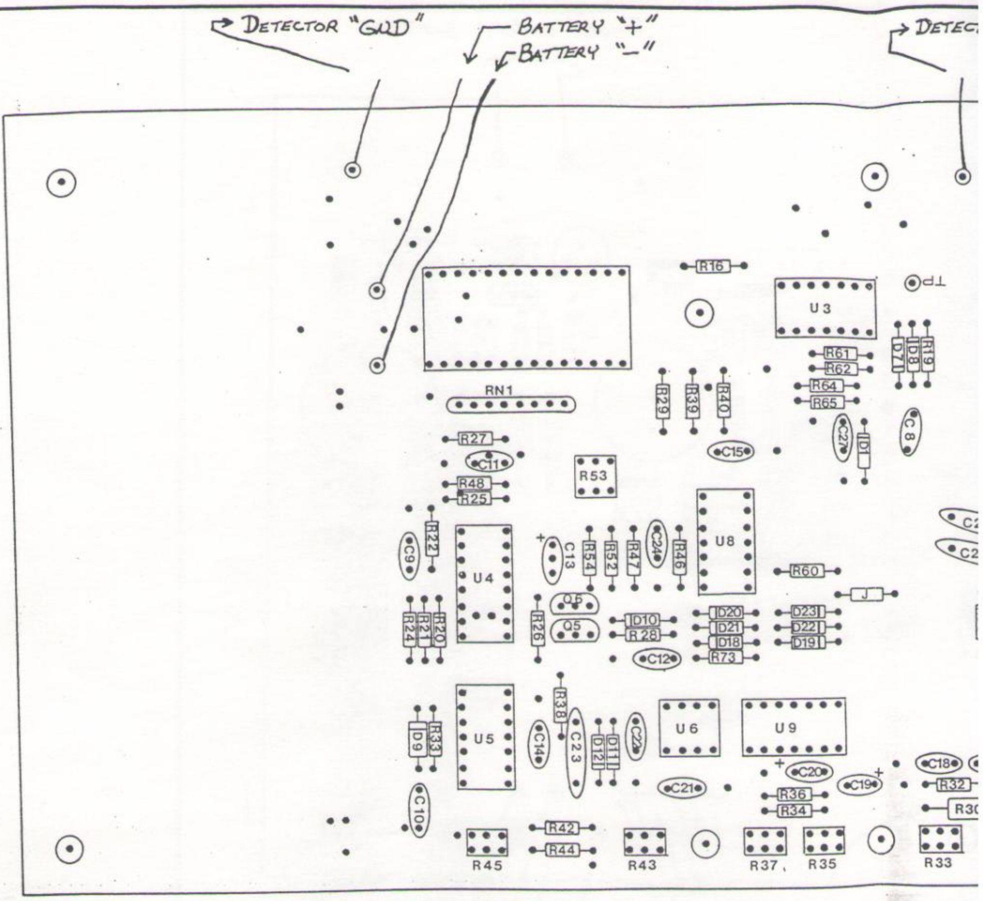
COMPONENT LOCATIONS
LABTECH SWITCH BOARD

BASIC PART NUMBER | Dimension | FINISH | REV.

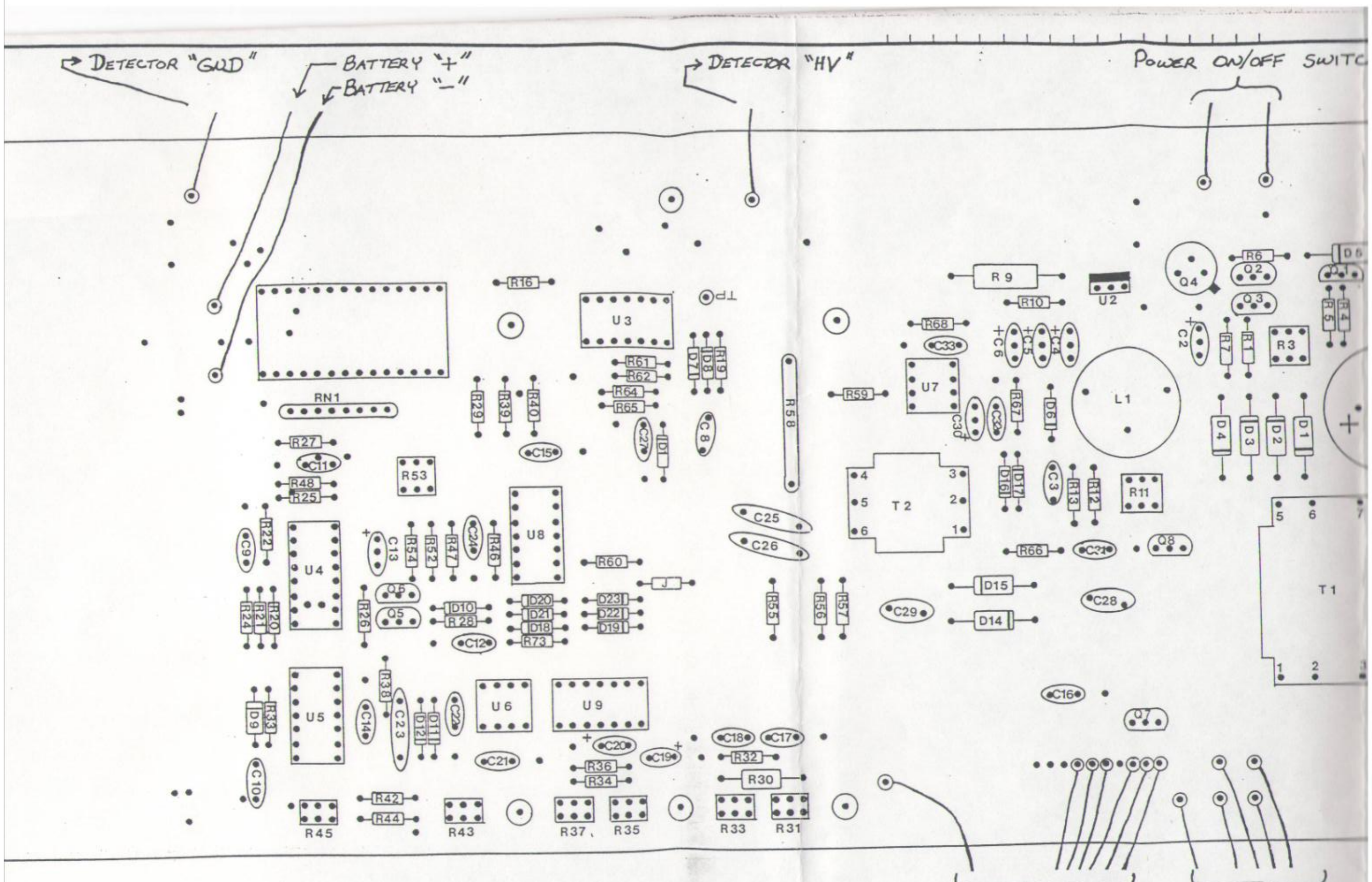


TOLERANCES UNLESS OTHERWISE SPECIFIED	SCALE: 1.25 : 1	**BICRON CORPORATION** NEWBURY, OHIO U.S.A.
FRAC. ± .X ± .XX ± .XXX ±	DRAWN: JAR DATE: 1-31-86	
ANGLES ± °	CHECKED:	COMPONENT LOCATIONS
MICRO FIN. √	DATE:	LABTECH MAIN BOARD
BY	DE-BURR & BREAK ALL EDGES	DO NOT SCALE PRINT

PROD. CODE	Dwg.Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B1	031012			

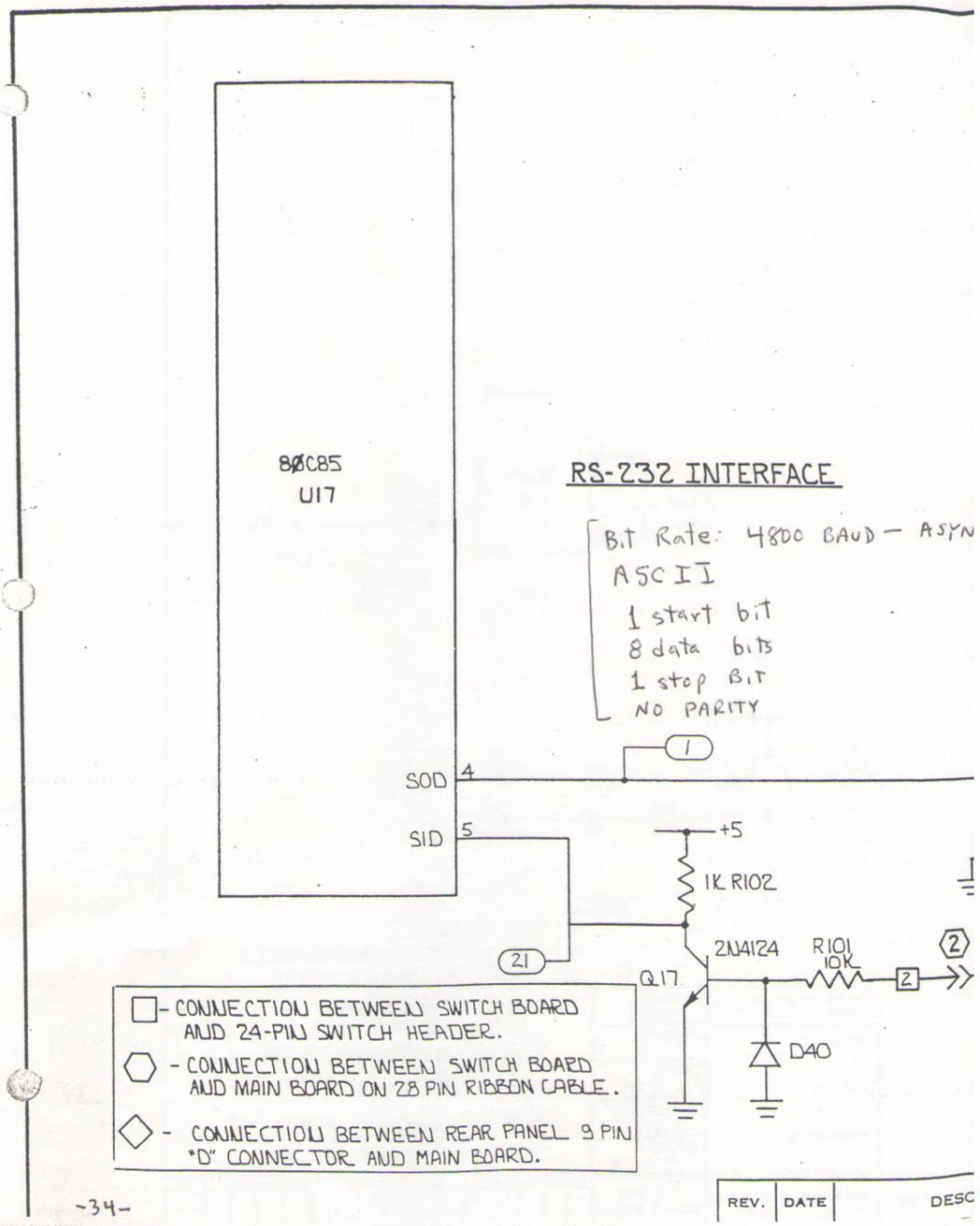


REV.	DATE	DESCRIPTION



TOLERANCES UNLESS OTHERWISE SPECIFIED	SCALE: 1.25 : 1
FRAC. ±	DRAWN: JAR
.X ±	DATE:

BICR
CORPO
NEWBURY



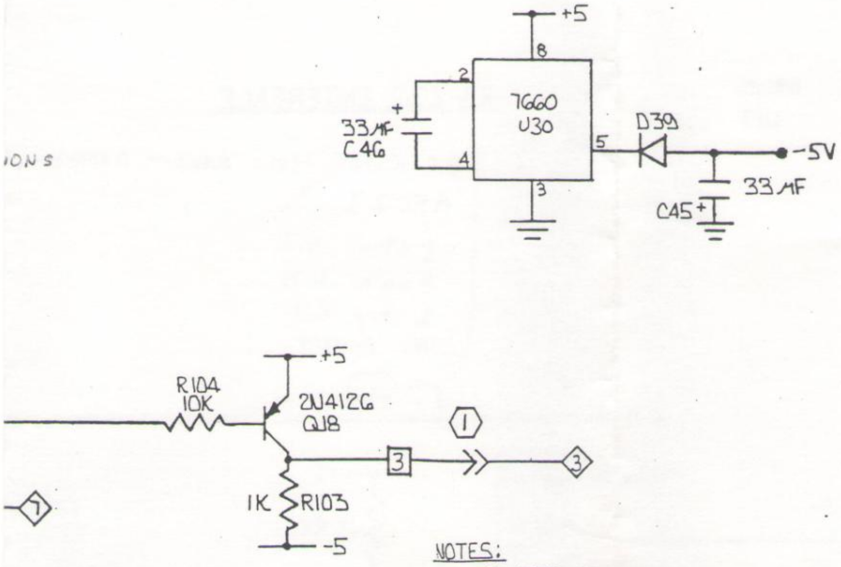
RS-232 INTERFACE

Bit Rate: 4800 BAUD — ASYN
ASCII
1 start bit
8 data bits
1 stop Bit
NO PARITY

□ - CONNECTION BETWEEN SWITCH BOARD AND 24-PIN SWITCH HEADER.

⬡ - CONNECTION BETWEEN SWITCH BOARD AND MAIN BOARD ON 28 PIN RIBBON CABLE.

◇ - CONNECTION BETWEEN REAR PANEL 9 PIN "D" CONNECTOR AND MAIN BOARD.



NOTES:
ALL RES. IN OHMS
ALL CAPACITORS IN MICROFARADS
ALL UNMARKED DIODES IN4148

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °
MICRO FIN. √
DE-BURR & BREAK ALL EDGES

SCALE: NONE
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NEWBURY, OHIO U.S.A.

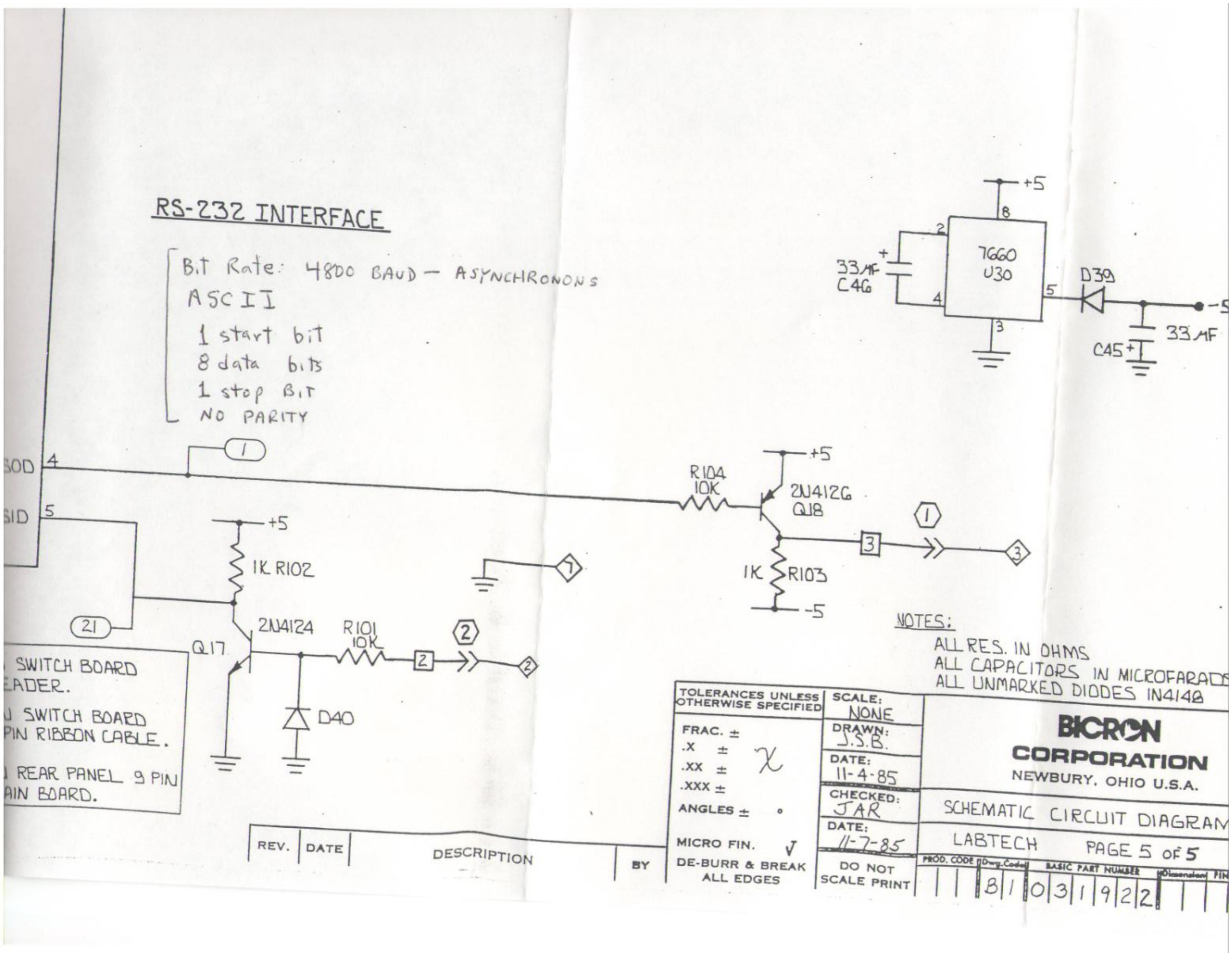
SCHEMATIC CIRCUIT DIAGRAM
LABTECH PAGE 5 OF 5

PROD. CODE	Dwg. Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B 1	0 3 1 9 2 2			

BY

RS-232 INTERFACE

Bit Rate: 4800 BAUD — ASYNCHRONONS
ASCII
1 start bit
8 data bits
1 stop Bit
NO PARITY



NOTES:
ALL RES. IN OHMS
ALL CAPACITORS IN MICROFARADS
ALL UNMARKED DIODES IN4148

REV. | DATE | DESCRIPTION | BY

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °
MICRO FIN. √
DE-BURR & BREAK ALL EDGES

SCALE: NONE
DRAWN: J.S.B.
DATE: 11-4-85
CHECKED: JAR
DATE: 11-7-85
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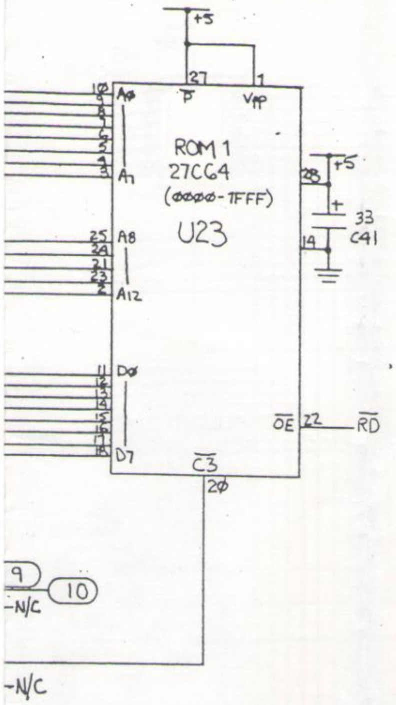
BICRON CORPORATION
NEWBURY, OHIO U.S.A.

SCHEMATIC CIRCUIT DIAGRAM
LABTECH PAGE 5 OF 5

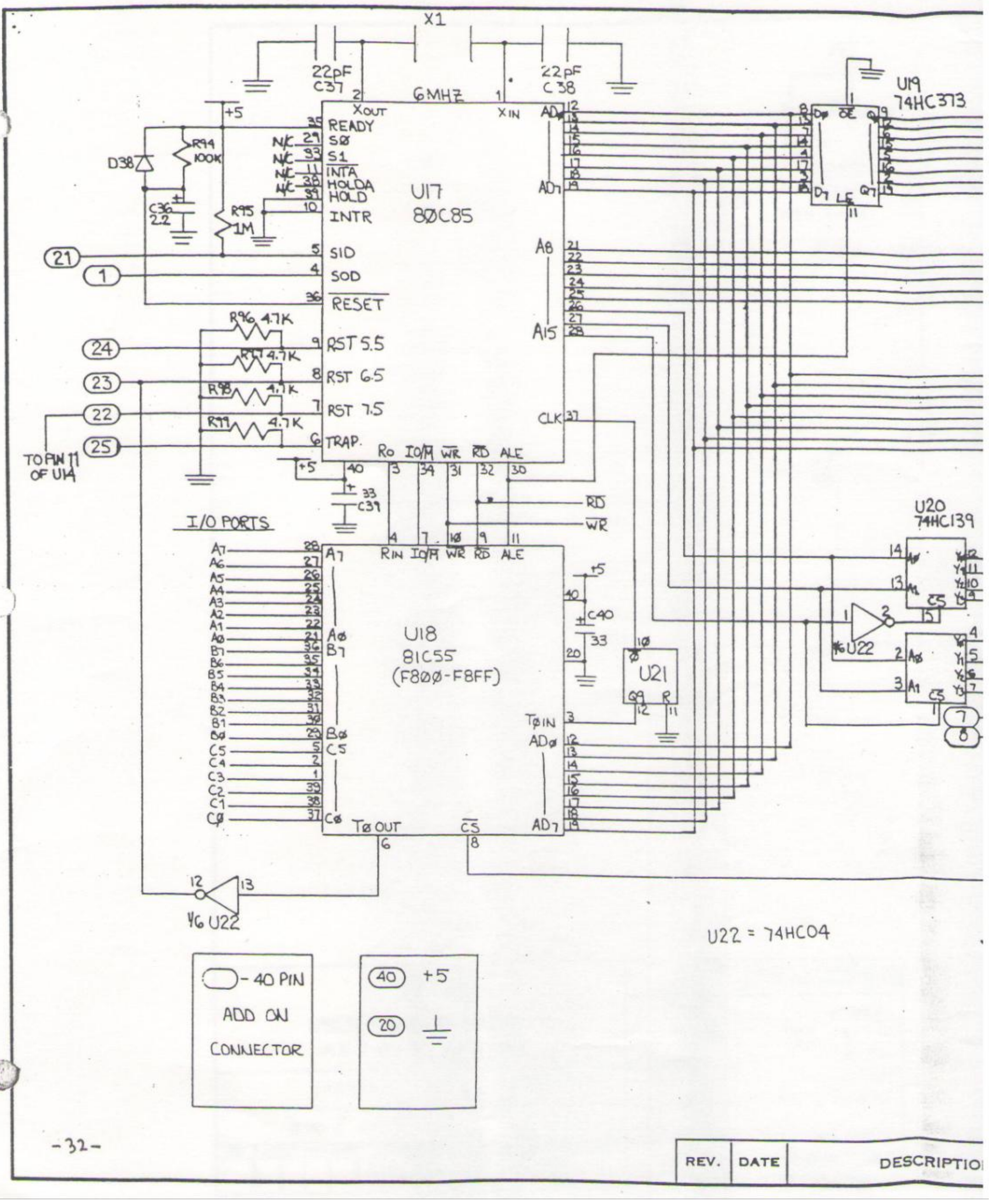
PROD. CODE | Dwg. Code | BASIC PART NUMBER
B1 | 0 | 31922

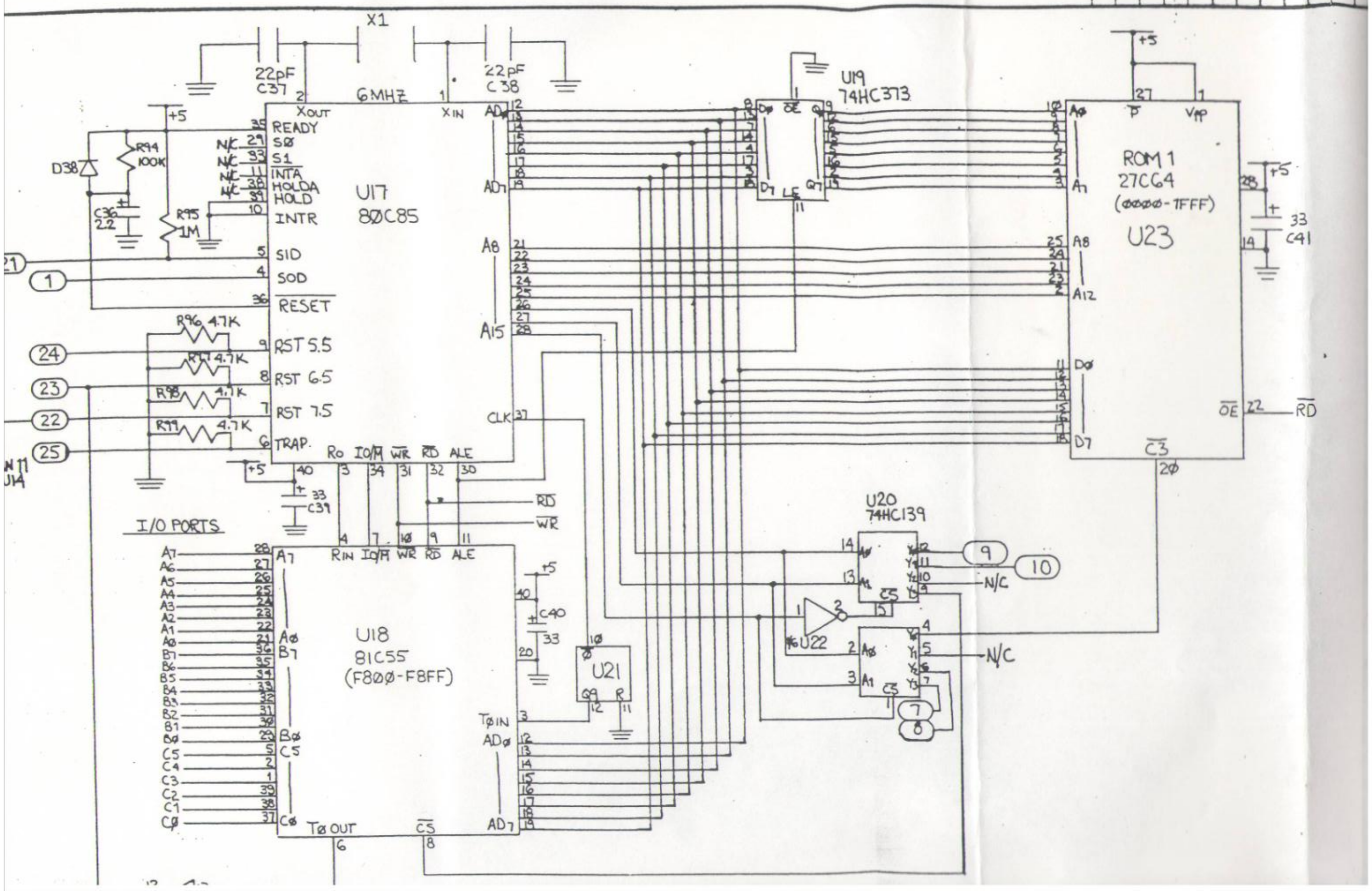


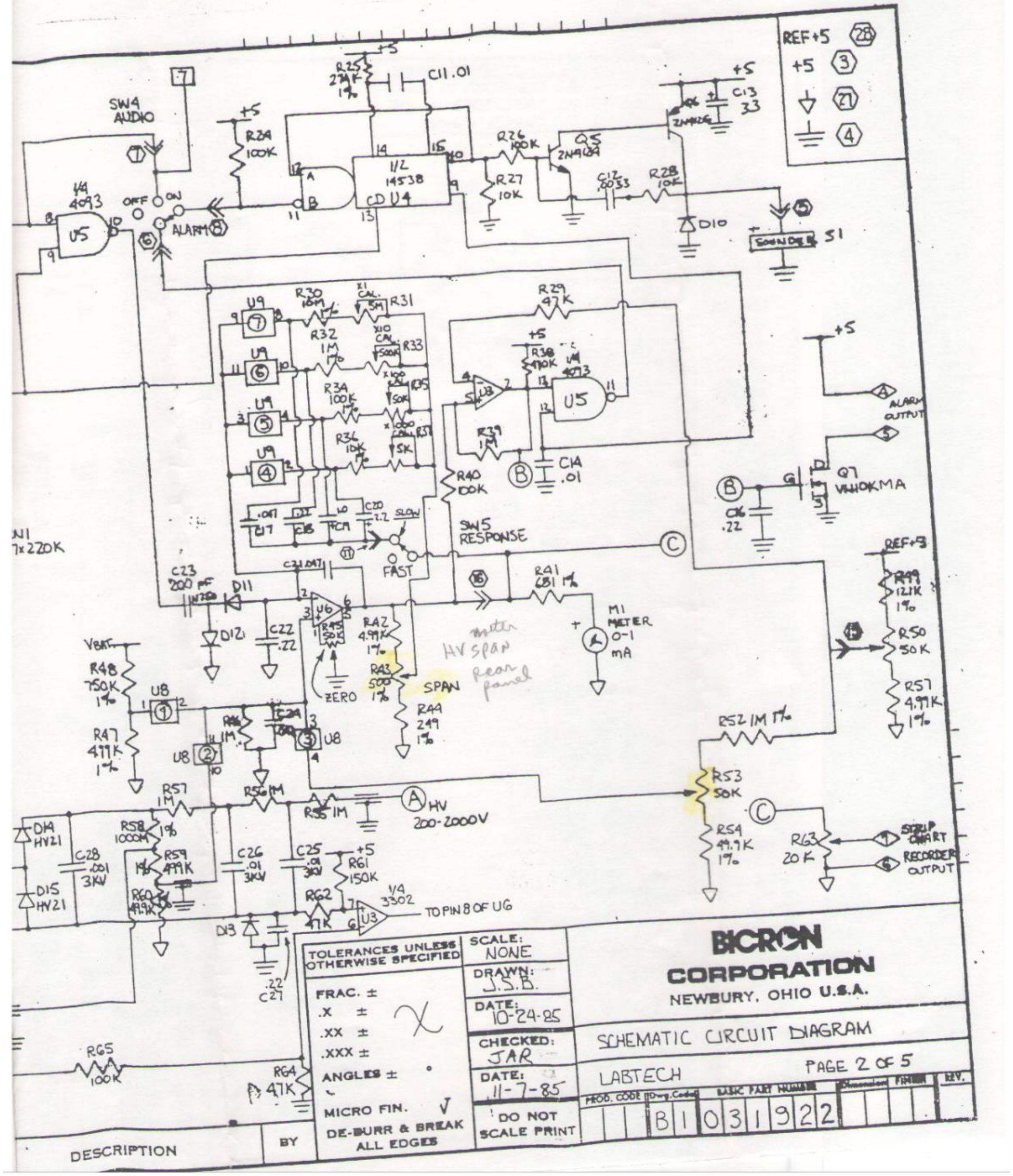
BY	TOLERANCES UNLESS OTHERWISE SPECIFIED FRAC. ± .X ± .XX ± .XXX ± ANGLES ± ° MICRO FIN. √ DE-BURR & BREAK ALL EDGES	SCALE: NONE DRAWN: J.S.B DATE: 10-23-85 CHECKED: JAR DATE: 11-7-85 DO NOT SCALE PRINT	**BICRON CORPORATION** NEWBURY, OHIO U.S.A. SCHEMATIC CIRCUIT DIAGRAM LABTECH PAGE 3 OF 5

X

PROD. CODE	Dwg. Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B	1 0 3 1 9 2 2			


X1
22pF
C37
6MHZ
22pF
C38
XOUT
XIN
U19
74HC373
OE
LE
+5
READY
S0
S1
INTA
HOLDA
HOLD
INTR
SID
SOD
RESET
N/C
D38
R94
100K
C36
2.2
R95
1M
U17
80C85
AD0
AD7
A8
A15
CLK
21
1
24
23
22
25
R96 4.7K
R97 4.7K
R98 4.7K
R99 4.7K
RST 5.5
RST 6.5
RST 7.5
TRAP.
TO PIN 11 OF U14
RO
IO/M
WR
RD
ALE
C39
I/O PORTS
A7
A6
A5
A4
A3
A2
A1
A0
B7
B6
B5
B4
B3
B2
B1
B0
C5
C4
C3
C2
C1
C0
RIN
U18
81C55
(F800-F8FF)
T0 IN
T0 OUT
CS
C40
U21
Q9
R
U20
74HC139
U22
1/6 U22
7
8
U22 = 74HC04
- 40 PIN
ADD ON
CONNECTOR
40
+5
20
REV.
DATE
DESCRIPTIO


X1
6MHZ
22pF C37
22pF C38
U17
80C85
XOUT
XIN
READY
S0
S1
INTA
HOLDA
HOLD
INTR
SID
SOD
RESET
RST 5.5
RST 6.5
RST 7.5
TRAP
R0 IO/M WR RD ALE
CLK
AD0
AD7
A8
A15
N/C
+5
D38
R94 100K
C36 2.2
R95 1M
R96 4.7K
R97 4.7K
R98 4.7K
R99 4.7K
C39 33
U19
74HC373
D0 OE Q0
D7 LE Q7
ROM 1
27C64
(0000-1FFF)
U23
A0
A7
A8
A12
D0
D7
P VPP
OE
CE
RD
WR
33 C41
U20
74HC139
A0 A1
Y0 Y1 Y2 Y3
CS
N/C
U22
U21
Q9 R
I/O PORTS
A7 A6 A5 A4 A3 A2 A1 A0
B7 B6 B5 B4 B3 B2 B1 B0
C5 C4 C3 C2 C1 C0
U18
81C55
(F800-F8FF)
RIN IO/M WR RD ALE
T0IN
T0 OUT
CS
C40 33
1
21
24
23
22
25
9
10
7
8
J1
J14



TOLERANCES UNLESS OTHERWISE SPECIFIED

FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °
MICRO FIN. √
DE-BURR & BREAK ALL EDGES

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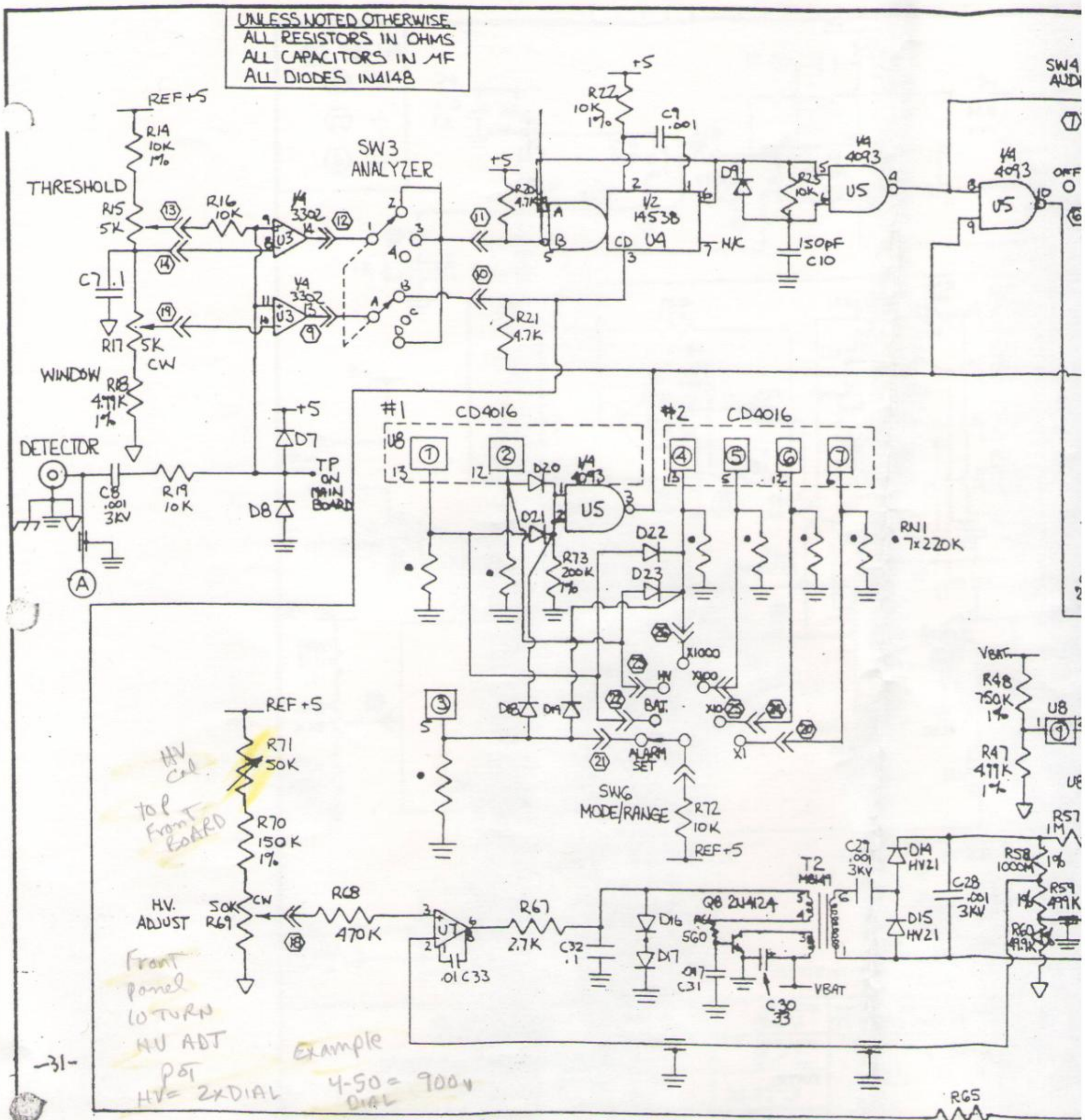
BICRON CORPORATION
NEWBURY, OHIO U.S.A.

SCHEMATIC CIRCUIT DIAGRAM

LABTECH

PAGE 2 OF 5

PROD. CODE	Dwg. Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B 1	0 3 1 9 2 2			


UNLESS NOTED OTHERWISE
ALL RESISTORS IN OHMS
ALL CAPACITORS IN µF
ALL DIODES IN4148

HV Cal

Top Front BOARD

Front panel 10 TURN HV ADJ POT HV= 2xDIAL

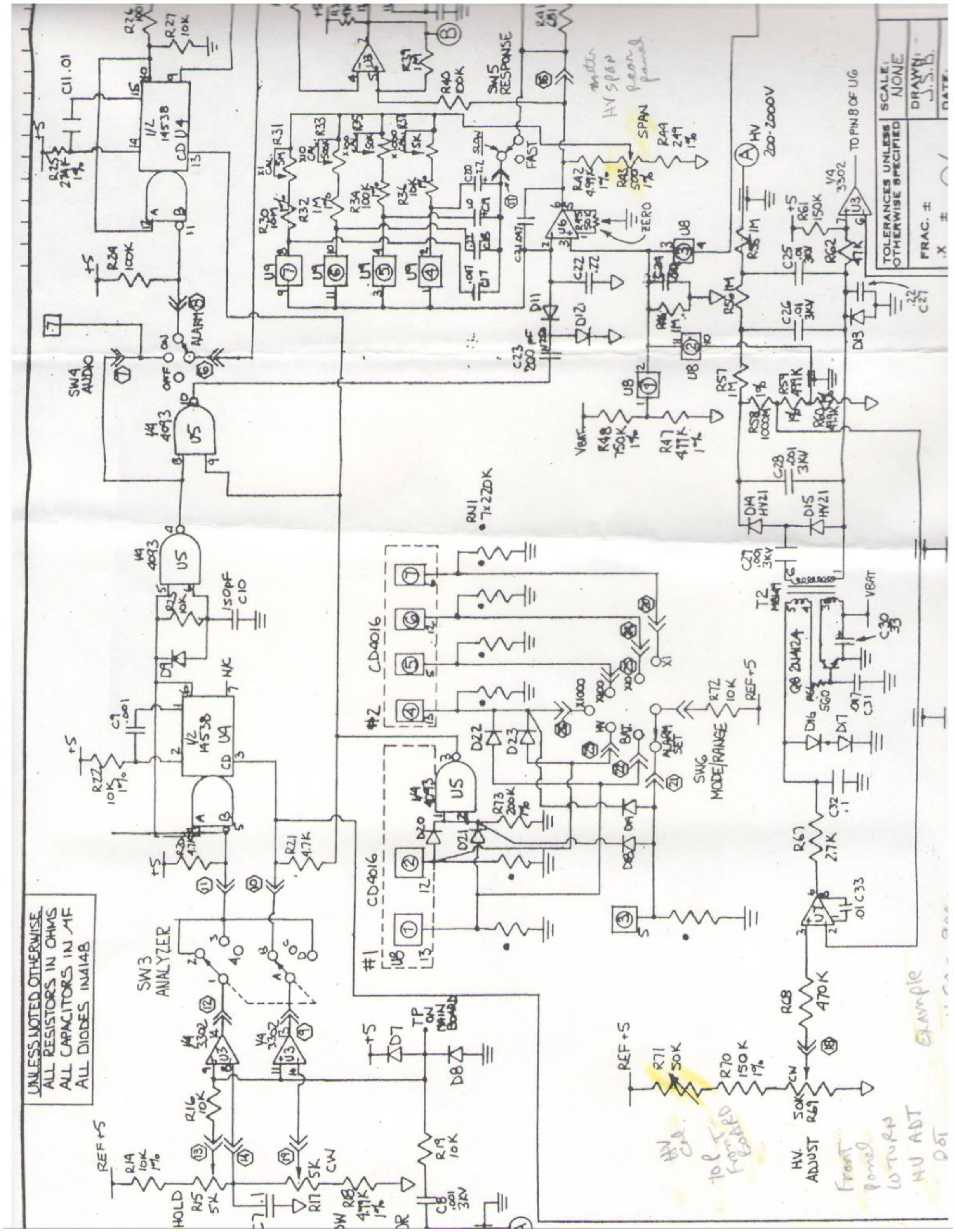
Example 4-50 = 900v DIAL

-<< CONNECTION BETWEEN SWITCH BOARD AND MAIN BOARD ON 28-PIN RIBBON CABLE.

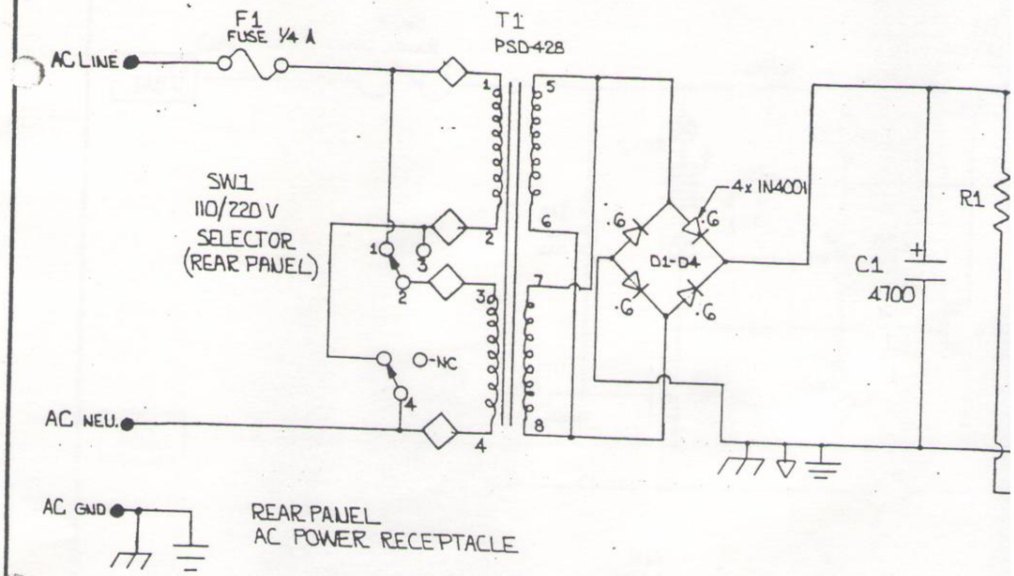
-◇- CONNECTION BETWEEN REAR PANEL 9-PIN "D" CONNECTOR AND MAIN BOARD

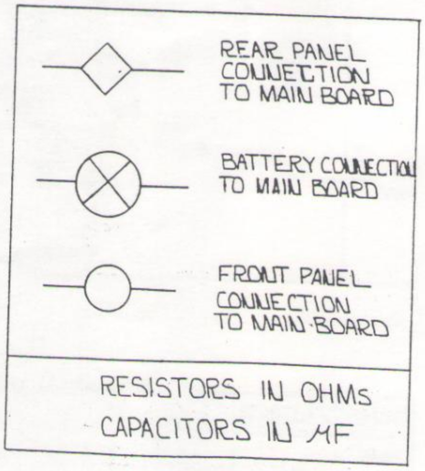
-☐- CONNECTION BETWEEN SWITCH BOARD AND 24-PIN SWITCH HEADER.

REV.	DATE	DESCRIPTION

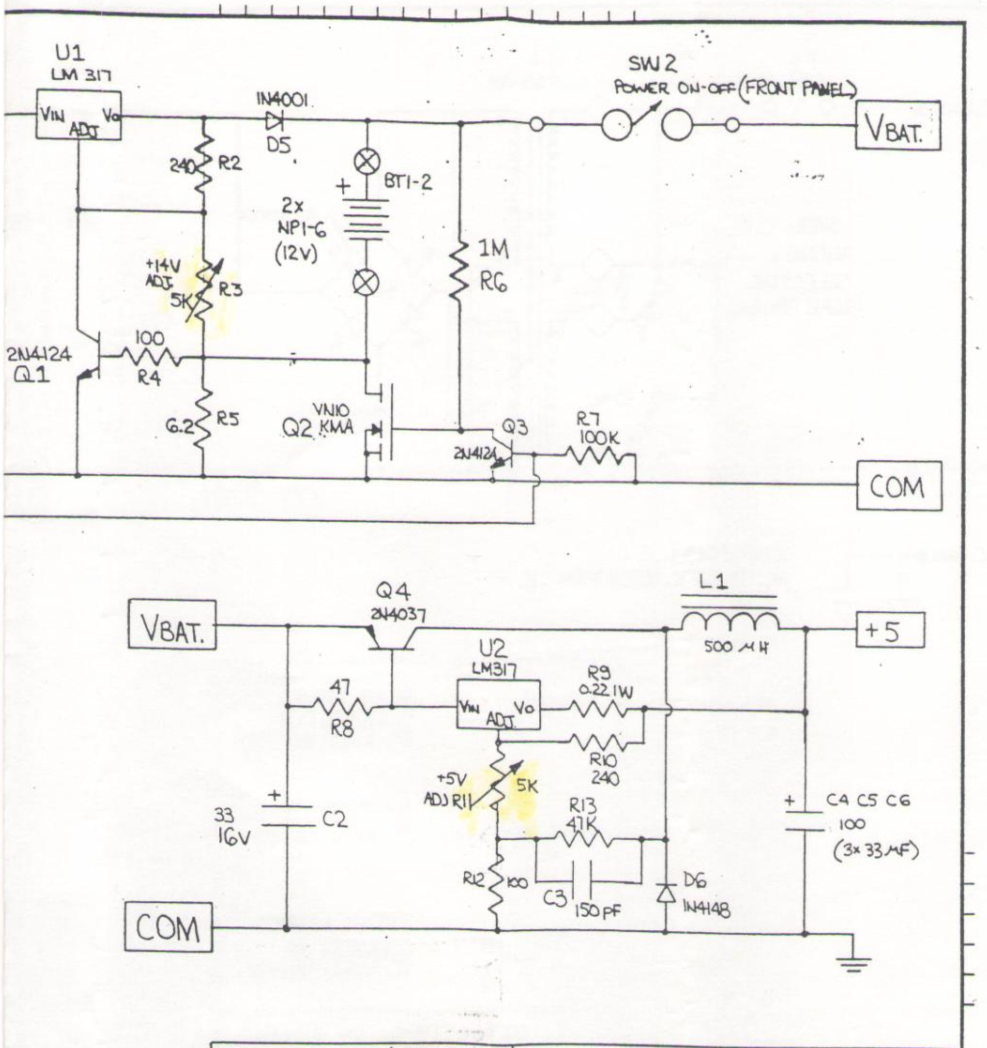


UNLESS NOTED OTHERWISE
ALL RESISTORS IN OHMS
ALL CAPACITORS IN MF
ALL DIODES IN4148
SW3 ANALYZER
SW4 AUDIO
SW5 RESPONSE
SW6 MODE/RANGE
ALARM
ON
OFF
FAST
SLOW
ZERO
SPAN
HV 200-2000V
TO PIN 8 OF U6
H.V. ADJUST
REF +5
VBAT
HOLD
TP ON MAIN BOARD
CD4016
1/2 14538 CD U4
1/4 4093 U5
1/4 3302 U3
RN1 7x 220K
T2
Q8 2N4124
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
SCALE: NONE
DRAWN: J.S.B.
DATE:
meter HV span rear panel
HV Cal
Top of Front board
Front panel 10 turn HV ADJ pot
Example




REAR PANEL CONNECTION TO MAIN BOARD
BATTERY CONNECTION TO MAIN BOARD
FRONT PANEL CONNECTION TO MAIN BOARD
RESISTORS IN OHMs
CAPACITORS IN μF

REV.	DATE	DESCRI



TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °
MICRO FIN. √
DE-BURR & BREAK ALL EDGES

SCALE: NONE
DRAWN: J.S.B.
DATE: 10-21-85
CHECKED: JAR
DATE: 11-7-85
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BICRON CORPORATION
NEWBURY, OHIO U.S.A.

SCHEMATIC CIRCUIT DIAGRAM
LABTECH
PAGE 1 OF 5

PROD. CODE	Dwg. Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B 1	0 3 1 9 2 2			

TION
BY

Model: LABTECH
Scaler/Ratemeter/Analyzer

BICRON®

Bicron Corporation
12345 Kinsman Road
Newbury, Ohio 44065
Telephone: (216) 564-2251
Telex: 980474
Telefax: (216) 564-8047

Bicron Corporation
European Office, P.O. Box 271
2410 AG Bodegraven The Netherlands
Telephone: 1726-14243
Telex: 39772
Telefax: 1726-14316

Features

- **MICROPROCESSOR CONTROLLED SCALER**
- **PRESET TIME AND PRESET COUNT MODES**
- **CRYSTAL CONTROLLED TIME BASE (NO LINE DEPENDENCE)**
- **7 DECADE LED DISPLAY**
- **FRONT PANEL CONTROLS**
- **SINGLE CHANNEL ANALYZER**
- **GM OR SCINTILLATION DETECTORS**
- **ADJUSTABLE HV**
- **AUDIBLE ALARM**
- **RECHARGEABLE BATTERY**

GENERAL: The **LABTECH model** combines a single channel analyzer, ratemeter, and a microprocessor controlled scaler into one unit. The scaler time base is crystal controlled for superior accuracy.

Presentations on both the analog and digital displays are selected by the user. The analog meter displays instantaneous counts per minute, the HV or alarm setting, or the battery condition.

The LED display indicates the test functions, the preset time or counts during set-up, or elapsed counts during a measurement.

Also, the microprocessor permits interrupting the measurement to call up elapsed time or counts, preset time or counts, or the calculated average CPM on the LED display

The measurement then can be resumed at the point of interruption. This allows completion of the measurement without a loss of data.

The single channel analyzer permits energy discrimination and background reduction.

A recorder output is provided. Outputs to computers (e.g. RS-232) and other devices are available as options.

The LABTECH's compact size, light weight, and standard features make it a very versatile package. Options are available to expand its capabilities even further.

Model: LABTECH Specifications

DETECTOR: Choice of GM and scintillation detectors
HIGH VOLTAGE: Electronically stabilized, adjustable to 2000 V via a calibrated turns counting dial, with readout on the meter
CONNECTOR (detector): MHV
INPUT SENSITIVITY: Adjustable from 0.1 to 1 V via a turns counting dial
WARMUP TIME: None
POWER REQUIREMENTS: AC, 110V/60Hz or 220V/50Hz, switch selectable
BATTERY: Rechargeable gelled cells providing 8 hr of operation
RECHARGE: Automatic when connected to line power; unit may be either on or off
AUDIO: Switch selectable to provide an audible "click" for each detector pulse or an audible alarm
ALARM: Audible, non-latching, rate alarm with front panel adjustment from 10% to 130% of full scale and readout on the meter
AUDIO CONTROL: Three position rotary switch
TEMPERATURE: Operational from -20° to + 50°C
HUMIDITY: <5% change in reading from 10-95% RH
SIZE: 12.5"L x 7.5"D x 5.5"H (31.8 x 19.1 x 14 cm) including feet and folded handle
WEIGHT: 7 pounds (3.2 kg)

SCALER SECTION

OPERATING MODES: Switch selectable as follows:

MANUAL - continuous counting

PRESET TIME - 0.1 to 999.9 min in 0.1 min increments, stored in memory

PRESET COUNT - 100 to 999,000 counts in 100 count increments, stored in memory

TEST - Exclusive self-test of scaler operation

RANGE: 0-9,999,999 counts; 0-99,999.99 minutes
TIMER: Crystal controlled time base with an accuracy of 0.05% or better, AC or battery power
DISPLAYS: 7 decade LED; indicator lamps for 'elapsed', 'preset', 'minutes', and 'counts'
CONTROLS: Four position rotary switch; pushbuttons for 'count', 'hold', 'reset', and 'set'

RATEMETER SECTION

RANGE: Four linear ranges of

0-1000 cpm
0-10,000 cpm
0-100,000 cpm
0-1,000,000 cpm

ACCURACY: Within 10% of reading between 20% and 100% of full scale on any range
RESPONSE TIME: Switch selectable, optimized for each range, 0-90% of final reading as follows:

	Time	
Range	Fast	Slow
X1	8 sec	15 sec
X10	1 sec	5 sec
X100	<1 sec	2 sec
X1000	<1 sec	1 sec

DISPLAY (meter): Ruggedized, recessed, high-torque 1 mA meter with 3.35in (8.51cm) scale marked:

0-1000 cpm and 0-2.0 kilovolts, with 'Bat. ok' check band

Meter protected by impact-resistant Lexan® polycarbonate window
GEOTROPISM: Within ± 2% of full scale
SHOCK: 100g per lightweight machine of MIL-STD 202C, method 202B
VIBRATION: 5g in each of three mutually orthogonal axes at one or more frequencies from 10-33Hz
CONTROLS: Seven position rotary switch; rotary fast/slow response switch

SINGLE CHANNEL ANALYZER

MODES: Selected by front panel control as follows:

CHANNEL 1 - Accepts signals within the analyzer window only

CHANNEL 2 - Accepts signals above the analyzer window only

OUT - Accepts all signals above the Lower Level Discriminator

LOWER LEVEL DISCRIMINATOR: Adjustable from < 0.1 to 1V via a turns counting dial
WINDOW: (Upper Level Discriminator) adjustable from 0 to 1V above the Lower Level Discriminator setting via a turns counting dial
PULSE-PAIR RESOLUTION: Typically 10 microseconds or less

Options/Accessories:

- RS-232 interface
- Dual channels for simultaneous alpha and beta counting
- Digital alarm
- Custom detectors
- Custom interfaces

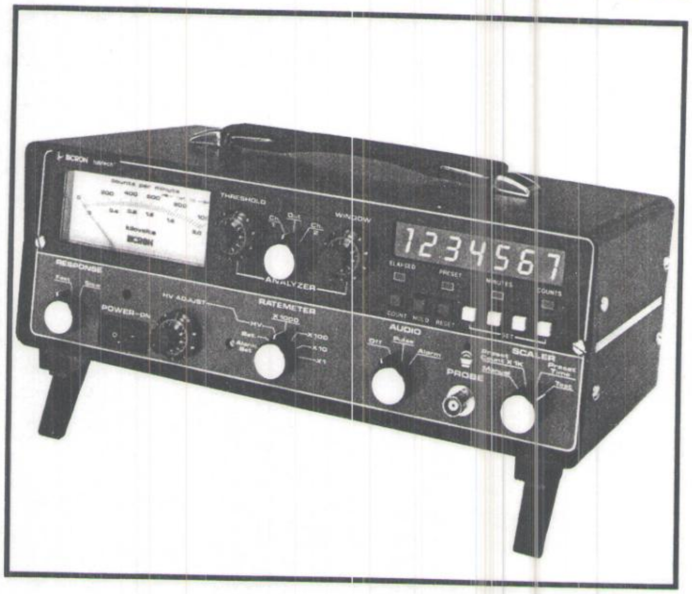
Manufacturer reserves right to alter specifications.

labtech™

Scaler/Ratemeter/Analyzer

Features

- MICROPROCESSOR CONTROLLED SCALER
- PRESET TIME AND PRESET COUNT MODES
- CRYSTAL CONTROLLED TIME BASE
- 7 DECADE LED DISPLAY
- FRONT PANEL CONTROLS
- SINGLE-CHANNEL ANALYZER
- GM OR SCINTILLATION DETECTORS
- ADJUSTABLE HV
- AUDIBLE ALARM



GENERAL: The **labtech model** combines a single channel analyzer-based ratemeter and a microprocessor controlled scaler into one unit. The scaler time base is crystal controlled for superior accuracy.

All controls are front panel mounted, easy to read, and positioned for ease of operation. Both analog and digital displays are large and easy to read.

The ratemeter section is equipped with a single channel analyzer which permits energy discrimination and background reduction.

A recorder output is provided. Outputs to computers (e.g. RS-232) and other devices are available as options.

BICRON®

labtech™

Specifications

DETECTOR: Choice of GM and scintillation detectors

HIGH VOLTAGE: Electronically stabilized, adjustable to > 1600 V (typically 2000V) via a turns counting dial, with readout on the meter

CONNECTOR (detector): MHV

INPUT SENSITIVITY: Adjustable from 0.1 to 1V via a turns counting dial

WARMUP TIME: None

POWER REQUIREMENTS: AC, 110V/60 Hz or 220V/50 Hz, switch selectable

BATTERY: Rechargeable gelled cell which provides 8 hrs of operation

RECHARGE: Automatic when unit is connected to line power; unit may be either on or off

AUDIO: Switch-selectable to provide an audible 'click' for each detector pulse, or an audible alarm

ALARM: Audible, non-latching rate alarm with front panel adjustment from 30% to 130% of full scale and readout on the meter.

AUDIO CONTROL: Three position rotary switch

TEMPERATURE: Operational from -20° to +50°C

HUMIDITY: < 5% change in reading from 10-95% RH

SIZE: 12.5"L x 7.5"D x 5.5"H including feet and folded handle (31.8 x 19.1 x 14.0 cm)

WEIGHT: 7.5 lbs. (3.4kg)

SCALER SECTION

OPERATING MODES: Switch-selectable as follows:

Manual - continuous counting

Preset Time - 0.1 to 999.9 min. in 0.1 min. increments, stored in memory

Preset Count - 100 to 999,000 counts in 100 count increments, stored in memory

Test - Exclusive self-test of scaler operation

RANGE: 0-9,999,999 counts; 0-99,999.99 minutes

TIMER: Crystal controlled time base with an accuracy of 0.05% or better, AC or battery power

DISPLAYS: Seven decade LED; indicator lamps for 'elapsed', 'preset', 'minutes' and 'counts'

CONTROLS: Four position rotary switch; push buttons for count, hold, reset and set

RATEMETER SECTION

RANGE: 0-1,000,000 CPM in four linear ranges

ACCURACY: Within 10% of reading between 20% and 100% of full scale on any range

RESPONSE TIME: Switch-selectable, optimized for each range, 0-90% of final reading as follows:

Range	Time	
	Fast	Slow
X1	12 sec.	20 sec.
X10	1 sec.	8 sec.
X100	<1 sec.	2 sec.
X1000	<1 sec.	1 sec.

METER: Ruggedized, recessed, high-torque 1 mA meter with 3.35 inch (8.51 cm) scale marked 0-1000 counts per minute and 0-2.0 kilovolts, with 'bat ok' band

RECORDER OUTPUT: 1 volt full scale into 1 megohm load

CONTROLS: Seven position rotary switch; rotary fast/slow response switch

SINGLE CHANNEL ANALYZER

MODES: Selected by front-panel control as follows:

Channel 1: Accepts signals within the analyzer window only

Channel 2: Accepts signals above the analyzer window only

Out: Accepts all signals above the lower-level discriminator

LOWER-LEVEL DISCRIMINATOR: Adjustable from < 0.1 to 1 V via a turns counting dial

WINDOW: Adjustable from 0 to 1 V above the lower-level discriminator setting via a turns counting dial

PULSE-PAIR RESOLUTION: Typically 10 μs or less

Manufacturer reserves right to alter specifications

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